PERFORMANCE OF WHEAT (TRITICUM AESTIVUM L.) PARENTS IN RELATION TO YIELD AND YIELD PARAMETERS

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ABSTRACT

An experiment was carried out at agriculture research farm of Kulbhaskar Ashram P.G. College, Prayagraj (U.P.) during Rabi Seasons of 2020-21 and 2021-22 to study of the Performance of Wheat (*Triticum aestivum* L.) Parents in Relation to Yield and Yield Parameters. There were24 parents C-306, Unnat Halna, PBW-226, PBW-502, UP-2382, PBW-550, DBW-16, DBW-17, WH-542, WH-711, HD-2687, WCW-95-3, WCW-95-2, WCW-98-41, PBW-175, UP-2425, Raj-3765, HD-2329, PBW-590 and UP-2338 were used as line while WH-1021, PBW-343, Halna and PBW-373 were used as tester which were analyzed in randomized blocks design with 3 replications. All the parents and their eighty percent (80%) F1s, obtained by crossing in line x tester were evaluated during Rabi seasons of 2020 -21 and 2021-22for grain yield per plant and related traits. On the basis of overall performance parents PBW-175, PBW373, UP2425, UP-2338 and PBW-502 were found good general combiner for yield per plant and gluten content with some other characters also which may improve yield as well as chapatti quality. Cross combinations PBW-226xPBW-373, PBW-502xPBW-343, WH-542xHalna were common for grain yield per plant and gluten content which can improve chapatti quality with grain yield.

Keywords : *Common bread wheat, line x tester, general combining ability and specific combining ability.*

INTRODUCTION

In wheat yield levels have been improved substantially through intensive and concerted breeding efforts hence further yield advances seem more difficult necessitating the application of newer breeding approaches. An effect prevailing in the breeding material is necessary to decide the kind of breeding procedure to be chosen for better exploitation of the genetic potential of different plant traits in a crop. An understanding of the genetic factors that govern the plant traits is necessary because breeding for yield depends largely upon genetic manipulation of the components along with yield. These characters are

polygenic and exhibit additive and non-additive genetic variation. Parents with significant GCA effects are useful for exploitation through conventional crossing programme and those with significant SCA effect are suitable for hybrid variety development. The concept of combining ability is considered to be a landmark in the development of efficient and effective breeding strategy in different crop plants. The knowledge of combining ability together with *per se* performance of parents, hybrids and heterotic response helps the breeder in selecting suitable parents and crosses for their use in systematic breeding programme (Sprague and Tatum, 1942). By resorting to this technique, the breeders come out with the best general combining parents and specific cross combination for future exploitation.

MATERIALS AND METHODS

C-306, Unnat Halna, PBW-226, PBW-502, UP-2382, PBW-550, DBW-16, DBW-17, WH-542, WH-711, HD-2687, WCW-95-3, WCW-95-2, WCW-98-41, PBW-175, UP-2425, Raj-3765, HD-2329, PBW-590 and UP-2338 were used as line while WH-1021, PBW-343, Halna and PBW-373 were used as tester to produce eighty crosses in a line x tester fashion design. Seeds of parents and F1 plants were sown in two rows with spacing 25 cm between rows and 15 cm between plants according to the randomized blocks design with 3 replications during rabi season *2020 -2021*and 2021-22 at agriculture research farm of Kulbhaskar Ashram P.G. College, Prayagraj (U.P.). Fifteen competitive plants in parents and F1's were sampled randomly. Observations were recorded on fifteen randomly selected plants from each plot for characters like, plant height, length of spike, number of tillers per plant, total number of spikelets per spike, biological yield per plant, harvest index, number of grain per spike, 1000 grain weight, dry gluten content and grain yield per plant while days to 50% flowering

and days to maturity were recorded on plot basis. The analysis of variance for combining ability was carried out according to method outlined by Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variance for combining ability (Table 1) revealed highly significant differences among parents as well as their progenies for most of the important traits. Present study has revealed the presence of mainly non-additive genetic variance with respect to all the characters. The mean degree of dominance $(\sigma^2 s / \sigma^2 g)^{0.5}$ was found greater than unity for all the traits indicating the involvement of over dominance. In earlier studies, role of non-additive genetic variance were reported by Kandil, *et al.* (2016) and Kumar *et al.* (2018) for yield per plant.

The concept of combining ability is considered to be a landmark in the development of efficient and effective breeding strategy in different crop plants. The knowledge of combining ability together with *per se* performance of parents, hybrids and heterotic response helps the breeder in selecting suitable parents and crosses for their use in systematic breeding programme (Sprague and Tatum, 1942). By resorting to this technique, the breeders come out with the best general combining parents and specific cross combination for future exploitation.

General Combining Ability Effects

For days to 50% Flowering, parents PBW-590,WH-1021, PBW-550, C-306 and UP-2425 were identified as a good general combiner while PBW-502, UP-2425, PBW-343, DBW-17 and HD-2687 were identified as best parents on the basis of *per se performance.* For days to maturity, parentsWCW-95-3, PBW-343, HD-2687, WCW-98-41, and PBW-175 were identified as a good general combiner while parents PBW-542, UP-2425, PBW-175, Raj-3765, PBW-373 were

identified as best parents on the basis of *per se performance.* For plant heights, parents HD-2687, UP-2382, WH-711, UP-2338, DBW-16 were identified as a good general combiner while parents UP-2382, HD-2687, WH-711, WH-1021, PBW-590 were identified as best parents on the basis of *per se performance.* For length of spike, parents WCW-95-2, PBW-373 were identified as a good general combiner while parents UP-2338, WCW-98-41, UP-2425, DBW-17, and PBW-343 were identified as best parents on the basis of *per se performance.* For tillers per plant, parents HD-2329, PBW-373 were identified as a good general combiner while parents PBW-343, WCW-98-41, DBW-17, UP-2425, and WH-1021 were identified as best parents on the basis of *per se performance.* For spikelets per spike, parents HD-2329, DBW-16, WCW-95-2, PBW-590, PBW-373 were identified as a good general combiner while parents UP-2338, UP-2425, PBW-343, DBW-17, WH-1021 were identified as best parents on the basis of *per se performance.* For biological yield per Plant, parents Unnat Halna, PBW-502, HD-2687, PBW-226,WCW-98-41 were identified as a good general combiner while parents Halna, C-306, Raj-3765, Unnat Halna, UP-2425 were identified as best parents on the basis of *per se performance.* For harvest index, parents UP-2382, DBW-16, HD-2687, WH-711, Raj-3765 were identified as a good general combiner while parents WH-1021, PBW-343, UP-2338, DBW-16,UP-2382 were identified as best parents on the basis of *per se performance.* For grain number per spike, parents Unnat Halna, C-306, HD-2329 were identified as a good general combiner while parents UP-2338, PBW-590, PBW-343, UP-2425, WH-1021 were identified as best parents on the basis of *per se performance.* For 1000 grain weight, parents C-306,WH-542, PBW-502, WCW-95-3, Raj-3765 were identified as a good general combiner while parents HD-2687, PBW-

550, PBW-175, WH-542, DBW-17 were identified as best parents on the basis of *per se performance.* For gluten content, parents PBW-175, PBW-373, UP-2425, UP-2338, PBW-502 were identified as a good general combiner while parents PBW-373, DBW-16, Raj-3765, HD-2687, WCW-95-3 were identified as best parents on the basis of *per se performance.* For grain yield per plant, parents HD-2329, WCW-95-2, DBW-16, UP-2382, Raj-3765 were identified as a good general combiner while parents UP-2338, PBW-343, WH-1021, DBW-17, UP-2425 were identified as best parents on the basis of *per se performance.*

A close examination of the Table reveals that the line Line C-306, DBW-16, HD-2329) combines well for the highest number of characters (six each) followed by HD2687 with five characters, PBW-502, WCW-95-2 and PBW-590 with four characters each and the lines Unnat Halna, WH-542, WH-711, WCW-98-41, PBW-175 and UP-2425 with three characters each, PBW-226, UP-2382, WCW-95-3, Raj3765 and UP-2338 with two characters each while line DBW-17 was good general combiner for none of the characters. Tester PBW-373 combines well for the highest number of characters (eight) followed by Halna (three), PBW-343 (three) and WH-1021 (two).

The estimates of gca effects of the parental lines, including lines and testers, for different characters revealed that none of the parental lines excelled in gca effects either for all the characters studied or at least for all the important yield components studied. This suggested the use of multiple parent participation through multiple crossing to affect substantial improvement in yield and its components. Similar results were reported by Kumar *et al.* (2018) and Tabassum *et al.*(2017).

Specific Combining Ability Effects

Specific combining ability represents the dominance and epistatic type of gene action and it

can be related with heterosis. If crosses showing high sca effects involve parents which are also good general combiner, these crosses could be exploited by simple methods like pedigree selection. In the present investigation, none of the crosses expressed good specific combining ability for all the traits under study. Out of 80 crosses combinations, nine best crosses were chosen on the basis of sca effects, per se performance and gca effects. Unnat HalnaxWH-1021 was found good for tillers per plant, biological yield per plant, grain number per spike, 1000 grain weight and grain yield per plant. PBW-226xPBW-373 was found good for harvest index, 1000 grain weight and grain yield per plant. PBW-502xPBW-343 was found good for spikelets per spike, biological yield per plant, grain number per spike, gluten content and grain yield per plant. DBW-17xPBW-343 was found good for spikelets per spike, biological yield per plant, grain number per spike and grain yield per plant. WH-542xHalna was found good for days to maturity, tillers per plant. Biological yield per plant, grain number per spike, gluten content and grain yield per plant. WH-711xPBW-343 was found good for tillers per plant, grain number per spike, 1000 grain weight and grain yield per plant. WCW-95-3xHalna was found good

for tillers per plant, spikelets per spike, biological yield per plant, grain number per spike and grain yield per plant. Raj-3765xWH-1021 was found well for length of spike, tillers per plant, spikelets per spike, biological yield per plant, harvest index, grain number per spike, 1000 grain weight and grain yield per plant. UP-2338xWH-1021 was found good for days to 50% flowering, spikelets per spike and biological yield per plant.

Out of 80 cross combination, on the basis of sca effects and *per se* performance five crosses viz; Unnat HalnaxWH-1021, PBW-502xPBW343, WH542xHalna, WCW-95-3xHalna, Raj-3765xWH-1021 were found superior. On the other hand, Unnat HalnaxWH-1021 was common for grain yield per plant. Crosses PBW-226xPBW-373, PBW-502xPBW-343, WH-542xhalna were common for gluten content and grain yield per plant which can improve chapatti quality with grain yield. These cross combination may be expected to be utilized in heterosis breeding programme and developing genotypes having broad genetic base by multiple crossing programme. Similar findings were reported by Kandil, *et al.* (2016), Kumar, *et al.* (2017) and Rajput and Kandalkar (2018).

Table - 1 : Analysis of variance for combing ability for twelve characters in common bread wheat (*Triticum aestivum* L.) (Mean data of 2 years)

Source of variation	DF	Days to 50% Flowering	Days to maturity	Plant heights	Length of spike	Tillers per plant	Spikelets per spike	Biological yield per plant	Harvest index	Grain number per spike	1000 grain weight	Gluten content	Grain yield per plant
GCA (Line)	19	26.7333	28.7532	386.9845**	0.6980	0.4549	16.1472	230.7319**	236.0914**	11.7697	41.0287	0.6360	9.9753
GCA (Tester)	3	212.611**	164.9042**	186.6491	2.10**	1.668**	15.0340	147.6700	235.5598	4.8183	7.88682	6.1512**	9.4888
SCA (Line x Tester)	57	38.9502**	24.3223**	155.3714**	0.6380**	0.513**	13.8694**	95.6833**	99.6992**	17.0395**	36.9557**	0.81512**	11.2834**
Error	158	1.2496	0.7334	6.6527	0.4315	0.1299	1.9446	1.0170	12.0453	2.78861	0.3258	0.02249	2.4219

Table - 2 : Estimates of components of variance, degree of dominance, additive and dominance component and heritability (narrow sense) for 12 characters in common bread wheat (*Triticum aestivum* L.) (Mean data of 2 years)

Components	Days to 50% Flowering	Days to maturity	Plant heights	Length of spike	Tillers per plant	Spikelets per spike	Biological yield per plant	Harvest index	Grain number per spike	1000 grain weight	Gluten content	Grain yield per plant
$\delta^2 \dot{g}$ (males)	2.101	2.328	31.754	0.025	0.029	1.194	19.15	18.384	0.58	3.36	0.051	0.599
$\delta^2 \dot{g}$ (females)	3.518	2.735	3.012	0.028	0.026	0.22	2.44	3.668	0.00	0.12	0.102	0.112
$\delta^2 \dot{g}$ (pooled)	3.282	2.667	7.802	0.028	0.026	0.382	5.22	6.12	0.097	0.66	0.094	0.193
$\delta^2 s$ (f x m)	12.475	7.833	49.811	0.08	0.134	4.015	31.58	28.07	4.081	12.1	0.264	2.833
$\delta^2 A$	6.564	5.334	15.604	0.056	0.053	0.765	10.459	12.241	0.194	1.322	0.187	0.386
$\delta^2 D$	12.475	7.833	49.811	0.080	0.134	4.015	31.583	28.07	4.081	12.10	0.264	2.833
$\delta^2 A / \delta^2 D$	0.526	0.681	0.313	0.699	0.393	0.190	0.331	0.436	0.048	0.10	0.708	0.136
$(\delta^2 D / \delta^2 A)^{0.5}$	1.379	1.212	1.787	1.196	1.595	2.291	1.738	1.514	4.583	3.02	1.188	2.709
$h^2 n$	33.57	39.68	23.15	20.75	23.57	14.19	24.69	26.91	3.30	9.69	40.80	9.30

Table 3 Ranking of desirable parent on the basis per se performance and gca effect for different characters in common bread wheat (Triticum aestivum. L.) (Mean data of 2 years)

S.No.	Character	Best parent per se performance in desirable direction	Best general combiner based on significant gca effect in desirable direction
1	Days to 50% Flowering	PBW-502, UP-2425, PBW-343, DBW-17,HD-2687	PBW-590,WH-1021, PBW-550, C-306, UP-2425
2	Days to maturity	PBW-542,UP-2425,PBW-175,Raj-3765,PBW-373	WCW-95-3, PBW-343, HD-2687, WCW-98-41,PBW-175
3	Plant heights	UP-2382,HD-2687,WH-711,WH-1021,PBW-590	HD-2687,UP-2382,WH-711,UP-2338,DBW-16
4	Length of spike	UP-2338,WCW-98-41,UP-2425,DBW-17,PBW-343	WCW-95-2,PBW-373
5	Tillers per plant	PBW-343,WCW-98-41,DBW-17,UP-2425,WH-1021	HD-2329,PBW-373
6	Spikelets per spike	UP-2338,UP-2425,PBW-343,DBW-17,WH-1021	HD-2329,DBW-16,WCW-95-2,PBW-590,PBW-373
7	Biological yield per Plant	Halna,C-306,Raj-3765,Unnat Halna, UP-2425	Unnat Halna,PBW-502,HD-2687,PBW-226,WCW-98-41
8	Harvest index	WH-1021,PBW-343,UP-2338,DBW-16, UP-2382	UP-2382,DBW-16,HD-2687,WH-711,Raj-3765
9	Grain number per spike	UP-2338,PBW-590,PBW-343,UP-2425, WH-1021	Unnat Halna,C-306, HD-2329
10	1000 grain weight	HD-2687,PBW-550,PBW-175,WH-542,DBW-17	C-306,WH-542,PBW-502,WCW-95-3,Raj-3765
11	Gluten content	PBW-373,DBW-16,Raj-3765,HD-2687,WCW-95-3	PBW-175,PBW-373,UP-2425,UP-2338,PBW-502
12	Grain yield per plant	UP-2338,PBW-343,WH-1021,DBW-17,UP-2425	HD-2329,WCW-95-2,DBW-16,UP-2382, Raj-3765

Table 4. Best cross combination on the basis of sca effect and per se performance for yield and other related traits in common bread wheat (*Triticum aestivu . L.*) (Mean data of 2 years)

S.No.	Crosses	sca value(Grain yield)	*Per Se*Peformance (Grain yield)	gca of parent		For other character
				P1	P2	
1	Unnat HalnaxWH-1021	4.948**	29.533	0.379	-0.489*	Tillers per plant, Biological yield per plant, Grain number per spike, 1000 grain weight, Grain yield per plant, Phenol colour reaction.
2	PBW-226xPBW-373	2.395*	26.773	-0.744	0.426*	Harvest index, 1000 grain weight, Grain yield per plant.
3	PBW-502xPBW-343	2.909**	26.993	-0.483	-0.129	Spikelets per spike, Biological yield per plant, Grain number per spike, Gluten content, Grain yield per plant.
4	DBW17xPBW343	3.277**	26.033	-1.811**	-0.129	Spikelets per spike, Biological yield per plant, Grain number per spike, Grain yield per plant.
5	WH-542xHalna	2.247*	27.827	0.691	0.191	Days to maturity, Tillers per plant. Biological yield per plant, Grain number per spike, Gluten content, Grain yield per plant.
6	WH-711xPBW-343	1.946*	25.913	-0.599	-0.129	Tillers per plant, Grain number per spike, 1000 grain weight, Grain yield per plant.
7	WCW-95-3xHalna	2.767**	28.160	0.504	0.193	Tillers per plant, Spikelets per spike, Biological yield per plant, Grain number per spike, Grain yield per plant.
8	Raj-3765xWH-1021	4.233**	29.207	0.767	-0.489*	Length of spike, Tillers per plant, Spikelets per spike, Biological yield per plant, Harvest index,Grain number per spike, 1000 Grain weight, Grain yield per plant.
9	UP-2338xWH-1021	2.689	25.400	-1.496**	-0.489*	Days to 50% flowering,Spikelets per spike, Biological yield per plant, Phenol colour reaction.

CONCLUSION

On the basis of above findings it is concluded that grain yield and its components were mainly controlled by both additive and dominance components with predominance of later therefore heterosis breeding will be suitable for the utilization of the present material. Parents C306, DBW-16, HD-2329 and HD-2687 and crosses Unnat HalnaxWH-1021, PBW-502xPBW-343, WH-542xHalna, WCW-95-3xHalna and Raj-3765xWH-1021 were found superior in the present study therefore these parents should be utilized in breeding programme along with superior crosses.

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PERCEPTION OF TEACHERS, STUDENTS AND PARENTS TOWARDS MID- DAY MEAL SCHEME

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ABSTRACT

The Mid Day Meal Scheme (MDMS) in India, initiated to enhance the nutritional status and educational outcomes of school children, has been a cornerstone in the country's education policy since its inception in 1995. This study explores the perceptions of teachers, students, and parents regarding the MDMS, focusing on its implementation in Varanasi district, Uttar Pradesh. Employing a survey methodology, data was collected from primary and upper primary schools in Pindra Block. Findings indicate that while the scheme has positively impacted enrolment and attendance, there are variations in preferences for meal options among students, with statistically significant differences observed between genders. Specifically, out of 150 children surveyed, 29.33% favored Halwa followed by rice and dal. However, no responses were reported for Kheer or Daliya. Furthermore, the majority of respondents reported no special meals provided, with preferences leaning towards traditional options like rice and dal. Notably, a significant proportion of students (94.67%) indicated that second servings of the meal were available, reflecting a commitment to maintaining hygiene standards. Additionally, teacher involvement in meal tasting predominantly involves principals (48%), followed by teachers (32%) and food suppliers (20%). These insights underscore the need for targeted interventions to improve meal diversity and address gender disparities in meal preferences, while also emphasizing the importance of administrative oversight and continued support for the successful implementation of the MDMS.

Keywords : *Mid day meal scheme, perceptions, meal preferences, enrolment, attendance, hygiene standards, administrative oversight.*

INTRODUCTION

The Mid Day Meal Scheme (MDMS) is a centrally sponsored program in India that was launched in 1995 to provide free meals to school children, with the aim of improving their nutritional status and increasing enrolment, retention, and attendance in schools. The scheme initially covered children in primary classes, but it was later extended to cover children in upper primary classes as well. The MDMS has been a significant success in terms of increasing enrolment and attendance in schools, particularly in rural areas, and improving the nutritional status of children. The scheme has also been credited with reducing the gender gap in education, as more girls have been enrolled in schools due to the provision of free meals.

The scheme is implemented by the state governments, with support from the central government, and is funded jointly by the central and state governments. The scheme is monitored by the Ministry of Human Resource Development, Government of India, and is implemented in all states and union territories in India.

The Mid Day Meal Scheme has undergone several changes and improvements over the years. In 2001, the Supreme Court of India directed all states to implement the scheme in all government-run primary schools. In 2004, the scheme was extended to cover children in upper primary classes as well. In 2015, the government introduced a new initiative called the National Programme of Mid Day Meal in Schools, which aims to improve the quality of food served under the scheme.TheMid Day Meal Scheme (MDMS) was introduced in India with the objective of providing free meals to school children and improving their nutritional status, as well as increasing enrolment, retention, and attendance in schools. The scheme has been implemented in Varanasi district of Uttar Pradesh, which is one of the largest and most populous districts in the state.

The performance of the Mid Day Meal Scheme in Varanasi district is of great importance, given the significance of the scheme in improving the educational and nutritional status of children in the district. The scheme has the potential to address malnutrition and improve the overall health of children, particularly those from disadvantaged backgrounds. The importance of the Mid Day Meal Scheme cannot be overemphasized, and it is crucial that the scheme is implemented effectively in Varanasi district to achieve its objectives. The findings of this study will be useful for policymakers, researchers, and practitioners in the field of education and nutrition, as well as for the wider community. Overall, this study will provide valuable insights into the performance of the Mid Day Meal Scheme in Varanasi district and suggest measures for its effective implementation.

MATERIALS AND METHODS

The state of Uttar Pradesh was selected purposively as the researcher belongs to this state and is familiar with the local language which would help in building up better rapport with the respondent farmers.

When we have a problem in mind, the next step is to obtain data which will help us to solve it. To some extent a problem will suggest its own methods. The researchers must be able to define clearly what he\she wants to measure & must find adequate methods for measuring it. Since the aim is to obtain complete & accurate information in the said studies, the procedure to be used, must be carefully planned. In the present study, the researcher has used Survey Method to study the existing condition. The survey method gathers data from a relatively large number of cases at a particular time. It is concerned with the statistics that results when data are abstracted from a number of individual cases. The word "survey" comprises of two words "sur" & "veeir" which means "above" & "see". Thus, accordingly, survey means "to look over to" "to oversee" & this is precisely we understand by term survey. Surveys are concerned with describing, recording, analyzing, and interpreting conditions that either exist or existed. Surveys are only concerned with conditions or relationship that exist, opinion that are held, processes that are going on, effects that are evident or trends that are developing.

In the present study, the researcher has used survey method to collect data regarding enrolment, attendance, &drop-out and to study the opinion of parents, students, & teachers towards the impact of Mid-Day Meal in Primary & Upper Primary schools of Pindra Block of Varansir District. School children associated with the mid day meal programme in the

three schools were purposively selected for the ascertaining the conduct of the programme. Thus, headmaster/ headmistress and teachers concerned with the implementation of mid day meal programme and cooks from the three schools were selected for the study.

Fifty school children selected randomly from the schools having poorest performance with regarded to conduct of the mid day meal programme were selected for conduct of the nutrition communication intervention. The children studying in classes V and VI of the school were selected from among the participants of the programme.

RESULTS AND DISCUSSION

To know the perception of teachers, students and parents towards Mid- Day Meal Scheme

Above table reveals the responses of children on best meal of Mid-day meal. Out of 150 children, 29.33% of children reported responses to Halwa followed by rice and dal. No responses were observed for Kheer or daliya . Statistically, significant differences were observed between male and female children responses to best meal in mid day meal.

Table 1: Best meal in Mid-day meal

Response on best Mid-day meal	Female children in Government schools		Male children in Government schools		Total children in Government schools	
	No	Percentage	No	Percentage	No	Percentage
NamkeenDaliya	10	17.86	8	8.51	18	12.00
Halwa	13	23.21	31	32.98	44	29.33
Rice and daal	13	23.21	26	27.66	39	26.00
Tahri	8	14.29	21	22.34	29	19.33
Kheer or Daliya	0	0.00	0	0.00	0	0.00
Khichadi	12	21.43	8	8.51	20	13.33
Total	**56**	**100**	**94**	**100**	**150**	**100**

Total 150 children and NGO workers were observed in the present study to observe Mid-day meal menu and following menu were observed in the present study as Monday- Daliya, Tuesday- Khichari, Wednesday- Rice dal, Thursday- Halwa, Friday- Tahri, Saturday- Kheer.

Responses of children on what is special in mid day meal

Above table highlights the children responses to special meal in Mid-day meal. Out of 150 children, Majority (80.67%) of them reported that no special Mid-day meal was given. However very few of them (total 19%) provided responses to fruits, biscuits and channa as special Mid-day meal. Statistically, no significant differences were observed between male and female children's responses regarding what is special Mid-day meal in Mid-day meal proramme.

Children responses to Mid-day meal for second serving of the meal.

Above table highlights the children responses to Mid-day meal for second serving of the meal. Majority (94.67%) of them reported that meal was also given on second serving. this show that school staffs were not willing to preserve male for next day, No bad intention to resale it, and inclined

Table - 2: Responses of children on what is special in mid day meal

Responses	Female children in Government schools		Male children in Government schools		Total children in Government schools	
	No	Percentage	No	Percentage	No	Percentage
None	44	78.57	77	81.91	121	80.67
Sweet Daliya	1	1.79	0	0.00	1	0.67
Fruits	6	10.71	5	5.32	11	7.33
Biscuits	3	5.36	6	6.38	9	6.00
Chanaa	2	3.57	6	6.38	8	5.33
Total	**56**	**100**	**94**	**100**	**150**	**100**

towards to maintain better hygienic environment in the school premises.

Table 3: Children responses to Mid-day meal for second serving of the meal

Responses	Female children in Government schools		Male children in Government schools		Total children in Government schools	
	No	Percentage	No	Percentage	No	Percentage
No	3	5.36	5	5.32	8	5.33
Yes	53	94.64	89	94.68	142	94.67
Total	**56**	**100**	**94**	**100**	**150**	**100**

Teachers responses to tasting of Mid-day meal before distributing to

    Above table shows the teachers responses to tasting of Mid-day meal. 48% of the teachers reported that meal was tasted by principal followed by 32 % of them reported that meal was tasted by teachers and only 20% of them reported that meal was tasted by food supplier

Table - 4 : Teachers responses to tasting of Mid-day meal before distributing to children

Sr. No	Mid-day meal tasted by	Number of Teachers	In Percentage
1.	Principal	12	48
2.	Teacher	8	32
3.	Food supplier	5	20
	Total	**25**	**100**

CONCLUSION

➢ Total 150 children and workers were observed in the present study to observe Mid-day meal menu and following menu were observed. Monday- Daliya, Tuesday- Khichari, Wednesday- Rice daal, Thursday- Halwa, Thursday- Halwa, Friday- Tahri, Saturday- Kheer. Out of 150 children, 29.33% of the children provided responses to Halwa followed by rice and dal for best meal in Mid-day meal. Statistically, significant differences were observed between male and female children

➢ Out of 150 Total children in Government schools none sweet, 80.67% of the children provided responses to followed by 78.57

per cent Female children inGovernment schools and male children inGovernment schools 81.91per cent for best meal in Mid-day meal. Statistically, significant differences were observed between male and female children.

➢ Above table highlights the children responses to Mid-day meal for second serving of the meal. Majority (94.67%) of them reported that meal was also given on second serving. Out of 25 teachers, 48% of the them reported that meal was tasted byprincipal followed by 32 % of them reported that meal was tested by teachers and only 20% of them reported that meal was tested by food supplier.

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EMPOWERING RURAL INDIA: ASSESSING THE SOCIO-ECONOMIC IMPACT OF PRADHAN MANTRIAWASYOJANA - GRAMIN (PMAY-G) BENEFICIARIES

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ABSTRACT

The Pradhan MantriAwasYojana - Gramin (PMAY-G) is a pivotal rural housing initiative aimed at providing affordable housing to India's rural populace. This study conducted in Sikrara block of Jaunpur district (Uttar Pradesh) during 2022-23 assesses the socio-economic conditions of PMAY-G beneficiaries and the program's impact on various demographic factors. Through a purposive selection process, 120 respondents were chosen, representing diverse age groups, genders, educational backgrounds, caste affiliations, occupations, family types, religions, social participation levels, and annual income brackets. The findings underscore the program's role in enhancing security, self-esteem, and socio-economic well-being among beneficiaries, particularly those from marginalized backgrounds. Key areas for future research include longitudinal studies, qualitative analyses, comparative assessments, geographical expansion, exploration of indirect impacts, evaluation of program components, sustainability assessments, and gender and social inclusion considerations. By addressing these aspects, future research can contribute to refining policies, enhancing program effectiveness, and promoting inclusive socio-economic development through PMAY-G.

INTRODUCTION

The Pradhan MantriAwasYojana - Gramin (PMAY-G), a pioneering rural housing program launched by the Government of India in 2016, stands as a beacon of hope for millions of rural citizens. With the overarching goal of providing affordable housing to the country's rural population, PMAY-G is an integral part of the government's ambitious initiative, "Housing for All," which aims to transform the dream of owning a home into a tangible reality for every Indian by the year 2022.India's rural landscape is dotted with aspirations and challenges. For many families, the dream of a secure and dignified dwelling remains elusive due to economic constraints, lack of resources, and inadequate infrastructure. Recognizing this pressing need, PMAY-G was conceived as a comprehensive solution to bridge the

housing gap and uplift the socio-economic conditions of rural beneficiaries.

Jaunpur district in Uttar Pradesh is a microcosm of the program's impact. Here, PMAY-G has woven a tapestry of change, touching the lives of countless families. As construction cranes rise against the horizon, hope blooms. Families once burdened by inadequate shelters now envision a brighter future—a future where their children grow up under sturdy roofs, where dignity and security prevail.Pradhan MantriAwasYojana - Gramin is more than a housing program; it is a testament to the government's commitment to social justice and inclusive growth. As we move toward the vision of "Housing for All," PMAY-G stands tall, laying the foundation for stronger communities, empowered individuals, and a rural India that thrives within the embrace of its own four walls.

MATERIALS AND METHODS

The research methodology employed in the study conducted in Sikrara block of Jaunpur district (Uttar Pradesh) during 2022-23 involved a purposive selection process based on geographic location, population, and the implementation of the Pradhan MantriAwasYojana - Gramin (PMAY-G) program in the area. Jaunpur district, situated in eastern Uttar Pradesh, was chosen due to its diverse socio-economic conditions, making it suitable for assessing the impact of the PMAY-G program. The district, covering an area of 4,038 square kilometers, comprises six tehsils and 21 development blocks, with Jaunpur city serving as the district headquarters. Five villages within the Sikrara block were selected based on the number of beneficiaries and accessibility under PMAY-G, with a total of 120 respondents chosen from these villages. The respondents were selected from the list of beneficiaries provided by the PMAY-G programofficials in the selected villages. This methodology ensured a comprehensive

understanding of the program's impact in the selected area while considering factors such as population distribution and program implementation. Descriptive statistics, such as means, percentage and standard deviations, were used to analyze the data.

Percentage:

The term 'percentage' means a fraction whose denomination is 100 and the numeration of the fraction is called Percentage. For calculating percentage, frequency was multiplied by 100 and divided by total no. of respondents.

Where, $P = \dfrac{X}{N} \times 100$

P = Percentage

X = Frequency of respondents

N = Total number of respondents

Mean:

The mean is defined as the arithmetic average of distribution of scores. It is determined by assigning the scores and dividing the sum by the number of scores. Symbolically the mean is given as:

$$\overline{x} = \frac{\Sigma x}{n}$$

Where,

X = Mean.

Σx = Sum of all the pairs in a distribution.

= Total number of items involved.

Standard deviation:

The standard deviation (S.D.) measures the absolute dispersion of variability of distribution. Here mean and standard deviation were used in categorization of respondents in different categories.

$$SD = \sqrt{\frac{\Sigma dx^2}{n} - \left(\frac{\Sigma dx}{n}\right)^2}$$

Where,

    SD = Standard deviation of sample.

    Σdx = Sum of total $(x - A)$

    x = each of the score in turn.

    n = Total number of scores in the distribution.

Age:

Table 4.1.1 shows that, highest percentage of the respondents belonged to the Middle age group 45-54 years 47.5 per cent, followed by 29.17 per cent in the Old age group 54-avobe years and 23.33 per cent belonged to the 25-44 Young age groups. The age group distribution of the respondents reflects that the study could capture the responses to the research based questions from all age group categories.

Table - 1 : Distribution of respondents according to their age

Sr. No	Category	Respondents	Percent
1.	Young	28	23.33
2.	Middle	57	47.5
3.	Old	35	29.17
Total		120	100

It is also noted that a few of the respondents 47 per cent of 45-55 years old age group has accessed the service of PMAY. Based on the available data, it may be inferred that Urban marginalized respondents from 45 -55 years have benefited most from the services of PMAY.The findings of Momani (2000) andOug (2003) conform the present finding.

Gender:

Table 2 shows that out of total 120 respondents, 65.83 per cent were males and 34.17 per cent were females. The male and female percentages of the present study are close to that of urban/metropolitan population.

Table - 2 : Distribution of respondents according to their gender

Sr. No	Category	Respondents	Per cent
1.	Male	79	65.83
2.	Female	41	34.17
Total		120	100.00

The study implies that as more of women benefitted in the Pradhan MantriAwasYojana [PMAY]- Urban Housing scheme and services, it is functioning as the seedbed for protecting their life and enabling their socio-economic condition more vibrantly. Another dimension observed in the study is that the PMAY scheme is an attractive service to the deprived people of urban area for finding their permanent dwelling. It has brought secured life to the socially disadvantaged groups in the urban area and enhanced their social status. The finding are in line with the finding of Zheng (2010).

Type of house:

Table 3 reveals that the respondent in the pucca houses were observed. It was found that most of the respondents 56.66 per cent lived pucca houses and 30.83 percent lived in Kaccha houses while only 12.50 per cent lived in Tin shed houses.

Table - 3 : Distribution of respondents according to their type of house

Sr. No	Category	Frequency	Percentage
1.	Kaccha	37	30.83
2.	Pucca	68	56.66
3.	Tin shed	15	12.5

Ownership of a house of any type gives a sense of security and belonging to the members. House is a source of self-esteem and dignity to the members. Ownership of a house promotes sanitation and healthy upbringing of children. The respondents

were distributed by type of house they owned and were presented in Table 4.1.3 The finding are in line with the finding of Rashid (2010).

Family Members:

Most of the respondents were head of the Family Members 29.17 per cent. Those respondents Grandfather/Mother of the Family Members, father/mother 38.33 per cent their relationship with the Family Members heads were son 18.33 per cent, daughter 14.17 percent,

Table -4 : Distribution of respondents according to their family members

Sr. No	Category	Respondents	Per cent
1.	Grand father/Mother	35	29.17
2.	Father/Mother	46	38.33
3.	Son	22	18.33
4.	Daughter	17	14.17
	Total	120	100

It is evident that 38.33 per cent respondents Father/Mother family were observed such who had member followed by 29.17 per cent Grand father/Mother family having members Thus, it is concluded that the majority of the respondents were found in medium family size category. The findings of Ahuja A. (2006) also confirm the present finding.

Education:

It is evident from Table 5 and that the Literacy is considered as one of the main parameter of human development. As expected, the educational qualifications of the beneficiaries, maximum respondents 43.33 per cent had middle education, followed by 26.67 per cent respondents possessed primary school education, 10.83 per cent had possessed secondary education, illiterate 10 per cent and only 9.17 per cent of the respondents possessed higher and above education.

Table - 5 : Distribution of respondents according to their education

Sr. No	Category	Respondents	Per cent
1.	Illiterate	12	10.00
2.	Primary	32	26.67
3.	Middle	52	43.33
4.	Secondary	13	10.83
5.	Higher	11	9.17
Total		120	100

Education is the process of bringing about desirable changes in human behavior. It improves one's capability to cope with different situations and also helps in taking correct decisions. The distribution of respondents according to their educational status was analyzed and presented. The findings of Nazrul (2004) and Ahuja A. (2006) also confirm the present finding.

Caste:

Caste wise distribution of the beneficiaries reveals 36.66 per cent from OBC caste, and 29.17 per cent General Castes, and 25 per cent of the Scheduled caste (SC/ST), and 9.17 per cent belonged to the Other caste.

Table - 6 : Distribution of respondents according to their caste

Sr. No	Category	Respondents	Per cent
1.	General	35	29.17
2.	OBC	44	36.66
3.	SC/ST	30	25
4.	Other	11	9.17
Total		120	100

The Guideline of PMAY(G) indicated that there will be multilayered prioritization within the

universe of eligible PMAY (G) beneficiaries. Priority will first be assigned based on parameters reflecting housing deprivation in each category viz., SC/ST, Minorities, and Others. Counting will begin with the houseless household, followed by the number of rooms; zero, one, and two rooms, in that order. In a particular social category viz., SC/ST, Minorities, and Others, households that are houseless or living in houses with a lower number of rooms shall not be ranked below households living in houses with a higher number of rooms. The work of Karan (2019).

Occupation:

Table 7 shows that a considerable number of respondents i.e 42.50 per cent were engaged in Farming, either in Farming + labours 30.00 per cent or in Farming + pvt. Job 19.17 per cent, and 8.33 per cent were other.

Table - 7 : Distribution of respondents according to their occupation.

Sr. No	Category	Respondents	Per cent
1.	Farming	51	42.50
2.	Farming + labours	36	30.00
3.	Farming + pvt. Job	23	19.17
4.	Other	10	8.33
	Total	120	100

Occupational status decides the Urban marginalized people to the extent of involvement in various income generation activities for livelihood. Occupation makes an individual to allocate more time in working and helps in family expenses management. The respondents had categorized based on their occupational status in following Figure 4.1.7 This finding finds support with the work of Shaw (2003) and Kohli (2004).

Family type:

The data presented in table 8 reveals that out of 120 mustard growers, 39.16 per cent belonged to nuclear family, and 60.84 per cent belonged joint family. Thus, it can be stated that the maximum mustard growers 60.84 per cent were of joint family.

Table - 8 : Distribution of respondents according to their family type

Sr. No	Categories	Frequency	Percentage
1.	Joint family	73	60.84
2.	Nuclear family	47	39.16
	Total	120	100

Since the type of family provides only social phenomena, an attempt has also been made to collect information on number of members in a given family of the respondents so that the influence of family size on different aspects related to PMAY can be observed. The work of Kaur (2012) and Kumar (2016) also confirms the present finding.

Religion:

Table 9 shows that majority of the beneficiaries were Hindus 60 per cent, and 30 per cent were Muslims and 10 per cent was other category. This percentage distribution in the present study does not vary much with that of Jaunpur city.

Religion is also a powerful and influential force with a significant effect on the human behavior. In India, majority of the people belongs to Hindu religion. The other religions include Christians, Muslims, Sikhs and Buddhists. Hence, for the purpose of the study, the respondents were divided into three religious group's viz., Hindus, Muslims and other.

Table - 9 : Distribution of respondents according to their religion

Sr. No	Category	Respondents	Per cent
1.	Hindus	72	60
2.	Muslims	36	30
3.	Other	12	10
	Total	120	100

The present study attempts to understand whether the religion of Urban deprived people has an influence on accessing PMAY schemes and services. The work of Jing (2019), Noah (2019)

Social Participation:

The data presented in Table 10 indicate that maximum 45.84 per cent of the respondents had medium social participation. The participation regarding to the low and high level were observed as 30 per cent and 24.16 per cent, respectively.

Therefore, it may be stated that most of the respondents had medium social participation.

Table - 10 : Distribution of respondents according to their Social Participation

Sr. No	Categories	Frequency	Percentage
1.	Low	36	30.00
2.	Medium	55	45.84
3.	High	29	24.16
Total		120	100.00

It is because the PMAY programme has initiated for progress through the Self Help Group, Non-Governmental Organization, Community Based Organization, Government Officials and Media, They acted as a key to deliver the awareness among the urban people in order to create adequate knowledge about the PMAY schemes and its importance. Therefore, the Urban people have the chance to grab the opportunity to construct their own house at subsidized financial assistance. This finding finds support with the work of Helan (2010), Thomas (2011), and Khan (2013).

Annual income:

From the Table 11 it was clear that 50.00 per cent of the respondents belonged to low level of annual income followed by medium 29.17 per cent and 20.83 per cent of the respondents have high level of annual income.

Table - 11 : Distribution of respondents according to their annual income

Sr. No	Category	Respondents	Per cent
1.	Low (<Rs36000)	60	50.00
2.	Medium (36000 to70000)	35	29.17
3.	High (70000)	25	20.83
Total		120	100

Income of the respondents seem to have a significant influence on their socio-economic status and it plays a key role in adoption of PMAY. Annual family income was measured using a measuring scale Kiran and Ravindra (2016) by grouping income categories as it was difficult to get exact income details from the respondents.

Future Scope:

Future research on the Pradhan Mantri Awas Yojana - Gramin (PMAY-G) program could encompass a longitudinal study to track long-term impacts, integrating qualitative methods for deeper insights into beneficiaries' experiences, and conducting comparative analyses with non-beneficiaries to gauge program effectiveness comprehensively. Geographically expanding the study, particularly to regions with similar socio-economic profiles, would enhance generalizability. Exploring indirect impacts on health and education, evaluating specific program components, assessing sustainability against environmental hazards, and investigating gender and social inclusion aspects represent critical areas for further inquiry. By addressing these facets, future research can contribute significantly to refining policies, enhancing program effectiveness, and promoting inclusive socio-economic development through PMAY-G.

CONCLUSION

The study conducted in Sikrara block of Jaunpur district (Uttar Pradesh) during 2022-23 aimed to assess the impact of the Pradhan

MantriAwasYojana - Gramin (PMAY-G) program on various socio-economic factors of the beneficiaries. The findings reveal significant insights into the demographic profile and socio-economic conditions of the respondents. Regarding age distribution, the majority of respondents belonged to the middle age group (45-54 years), followed by the old age group (54-above years), indicating a diverse representation across different age categories. Gender-wise, the study reflects a higher percentage of male respondents, while acknowledging the increasing participation of women in accessing PMAY-G services, which contributes to enhancing their socio-economic empowerment. Ownership of houses, educational qualifications, caste, occupation, family type, religion, social participation, and annual income were also analyzed to understand their influence on accessing PMAY-G benefits. The study underscores the importance of housing in promoting security, self-esteem, and socio-economic well-being among beneficiaries, especially those from marginalized backgrounds.

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ENTREPRENEURIAL BEHAVIOR OF RURAL WOMAN IN DAIRYING

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ABSTRACT

Entrepreneurial behavior among rural women, particularly in the dairy sector, holds significant potential for socio-economic development in India. This study delves into the entrepreneurial behavior of rural women engaged in dairying, aiming to understand their demographic characteristics, educational backgrounds, occupational engagement, family dynamics, extension participation, mass media exposure and entrepreneurial behavior traits. Conducted in Koilsa block of Azamgarh district, Uttar Pradesh, the research employed a descriptive research design with data collected through interviews from 100 respondents. Results indicate that middle-aged women dominate the dairy entrepreneurship landscape, with a substantial portion having attained secondary education. A majority are engaged in dairy alongside private jobs, while nuclear family setups are prevalent. Medium family sizes are common, with a significant proportion demonstrating medium levels of extension participation and mass media exposure. Notably, a substantial portion exhibit medium entrepreneurial behavior, influenced by factors such as educational attainment, occupational engagement, family structure and exposure to extension services and mass media. These findings shed light on the nuanced interplay of socio-economic factors shaping entrepreneurial behavior among rural women in the dairy sector, underscoring the need for targeted interventions to harness their entrepreneurial potential for sustainable rural development.

INTRODUCTION

The historical narrative of entrepreneurship in India is intricately interwoven with the fabric of its culture, customs and traditions. Initially confined to specific castes and occupations, entrepreneurial roles evolved with societal transformations. Post-World War II, entrepreneurship emerged as a catalyst for rapid economic growth, despite challenges from entrenched institutions, political instability, marketing barriers and traditional values influenced by British colonialism. Positioned at the forefront of economic advancement, entrepreneurship facilitates wealth distribution and service provision, serving as a vital instrument for socio-economic transformation. However, while traditionally women exhibited entrepreneurial traits through household management, their latent potential often went unrecognized. The post-independence era, marked by globalization and privatization, compelled women to explore

entrepreneurship, leading to remarkable strides across sectors. Today, women entrepreneurs epitomize success, leveraging inherent qualities such as hard work, patience, persuasion and communication skills. Nonetheless, rural women face distinct challenges including limited education, economic constraints, geographic constraints and structural barriers. Entrepreneurship emerges as a promising avenue to uplift rural women, offering self-employment opportunities and addressing the scourge of rural poverty. Central to economic activity, entrepreneurship drives development and fosters financial independence. Yet, despite the talent and aspirations, many aspiring entrepreneurs are hindered by financial dependence. Thus, the empowerment of rural women through entrepreneurship not only augments their socio-economic status but also contributes to broader economic growth and societal development.

MATERIALS AND METHODS

The study was conducted in the Koilsa block of Azamgarh district, Uttar Pradesh, during the year 2023. Azamgarh district, situated in the historical state of Uttar Pradesh, covers an area of 4234 square kilometers and is bounded by Nepal to the north, Bihar to the east, Rajasthan to the west, Haryana, Himachal Pradesh and Delhi to the northwest, Madhya Pradesh to the south and touches the borders of Jharkhand and Chhattisgarh to the southeast. Known for its fertile land traversed by the Ganga river, Uttar Pradesh comprises 75 districts and spans an area of 240,928 square kilometers. The Koilsa block was purposively selected due to its significant number of women dairy farmers. From this block, ten villages were randomly selected: Molnathpur, Zaframau, Amari Atraith, Kauria, Jalalpur, Deurpur, Ranipur and Dhandhari.

A descriptive research design was adopted for the study, allowing the collection of information without altering the environment. A schedule was constructed to facilitate data collection through interviews, a commonly applied method in survey research aimed at specific populations or samples. A random sampling technique was employed to select 100 respondents, ensuring the representation of women involved in dairy farming. Entrepreneurial behavior was assessed using six components: Managerial Ability, Leadership Ability, Innovativeness, Self-Possession, Planning Ability and Risk Orientation. Mean and standard deviation were utilized to measure these entrepreneurial traits, providing insights into the entrepreneurial behavior of rural women engaged in dairying activities in the study area. The familiarity of the researcher with the local language and socio-cultural aspects of Azamgarh district facilitated rapport-building and accurate data collection from the respondents, enhancing the reliability and validity of the study.

RESULTS AND DISCUSSION

Age

It is clear from the Table 1 that majority i.e.44 per cent of respondents were middle aged followed by old i.e. 32 per cent and young age i.e.24 per cent respectively.

Table - 1 :Distribution of respondent according to their age

Sr. No.	Age Categories (years)	Respondent (N = 100)	
		Frequency	Percentage
1.	Young (Below 35 years)	24	24
2.	Middle (35 to 55 years)	44	44
3.	Old (Above 55 years)	32	32
Total		100	100

Majority of the respondents are belong to the middle aged category because they are more enthusiastic to work more energetic and hardworking followed by old aged people because they have the sense of responsibility followed by young aged people. The results are in line with the findings of Nanda (2012).

Education:

It is evident from the Table 2 that majority i.e. 36.00 per cent of respondents were educated up to secondary school, 24.00 per cent were educated up to higher, 23.00 per cent respondents had primary education and 17. 00 per cent respondents were illiterate.

Table - 2 : Distribution of respondent according to their education

Sr. No.	Categories	Respondents (N = 100)	
		Frequency	Percentage
1	Illiterate	17	17
2	Primary	23	23
3	Secondary	36	36
4	Higher	24	24
	Total	100	100

Various government and non-government agencies have played a major role in developing an educated society. Efforts taken from so many years now have sounding affect now. This trend can be attributed to the high literacy status and reduced dropout rates of the state. It is considered mandatory for every child, either boy or girl, in every household to get educated. This high level of education makes the entrepreneurs to be aware of new opportunities as well as running of the enterprise smoothly. The results are in line with the finding of Nanda (2012).

Occupation:

It is clear from Table 3 that Majority of the respondents i.e. 43.00 per cent were involved in enterprise of dairy along with private job, 32.00 per cent of respondents were involved in dairy along with agriculture, 25.00 per cent of respondents were involved in enterprise of dairy along with government job.

Table - 3 : Distribution of respondent according to their occupation

Sr. No.	Category	Respondent (n) = 100	
		Frequency	Percentage
1.	Dairy + Govt.Job	25	25.00
2.	Dairy + Pvt.Job	43	43.00
3.	Dairy + Agriculture	32	32.00
	Total	100	100

Most of the respondents were involved in multiple enterprises, one of the major causes of this is increasing inflation and necessity and responsibility to feed family. Elimination of poverty is the main aim of rural women which make them stepping forth towards entrepreneurship. The results are in line with the findings of Tekale (2013).

Family Type:

It is clear from table 4 that majority of the respondents i.e. 61.00 per cent belonged to nuclear family and rest ie. 39.00 per cent belonged to joint family.

Table - 4 : Distribution of respondents according to their family type

Sr. No.	Category	Respondent (n) = 100	
		Frequency	Percentage
1.	Nuclear	61	61%
2.	Joint family	39	39%
Total		100	100%

Nowadays, joint family is assumed to be an obstacle in way of economic and industrial development because there is less independence to think beyond the four walls of house. The ever increasing needs, ambition and self-dependence of individuals give rise to nuclear families in the society. Findings are in line with Rathod (2011).

Family Size:

It is clear from table 5 that majority of the respondents i.e. 60.00 per cent belonged to medium size family, 28.00 per cent belonged to large family and 12.00 per cent belonged to small family.

Table - 5 : Distribution of respondent according to their family size

Sr. No.	Catrgory	Respondent (n) = 100	
		Frequency	Percentage
1.	Small	12	12
2.	Medium	60	60
3.	Large	28	28
	Total	100	100

The reason of family type holds good for family size too. Most of the people prefer to te in medium size family so that responsibilities could be shared and no one gets burdened. Findings are in line with **Bhosale (2014).**

Extension Participation:

It is clear from table 6 that majority of the respondents i.e. 64.00 per cent possess medium level of Extension participation followed by high i.e. 27.00 per cent and 9.00 per cent possess low level of extension participation.

Table - 6 : Distribution of respondents according to their level of extension participation

Sr. No.	Category	Respondent (n) = 100	
		Frequency	Percentage
1.	Low	9	9
2.	Medium	64	64
3.	High	27	27
	Total	100	100

Extension Participation of entrepreneurs plays a crucial role in smooth running and development of one's enterprise. It makes them aware and keeps them updated. Findings are in line with Beegam (2008).

Mass media Exposure:

It is clear from table7 that majority of the respondents i.e. 89.00 per cent of respondents possess medium level of mass media exposure followed by low level i.e. 8.00 per cent and high level i.e. 3.00 per cent of mass media exposure.

Table - 7 : Distribution of respondents according to their mass media exposure

Sr. No.	Category	Respondent (n) =100	
		Frequency	Percentage
1.	Low	8	8
2.	Medium	89	89
3.	High	3	3
	Total	100	100%

This is because those who are belonging to medium income category possess either a radio or television in their homes. However TV viewing was reported as the major means of cyposure. Besides all everybody have mobile phones which serve as fastest means. Findings are in line with Shreeram (2013).

Entrepreneurial Behaviour:

It is clear from table 8 that majority of the respondents i.e. 48.00 per cent possess medium level of entrepreneurial behavior followed by high i.e. 28.00 per cent and Low level i.e. 24.00 per cent of entrepreneurial behavior.

Table- 8 : Distribution of respondents according to their level of entrepreneurial behaviour

Sr. No.	Category	Respondents (n) = 100	
		Frequency	Percentage
1.	Low entrepreneurial brhaviour	24	24
2.	Medium entrepreneurial brhaviour	48	48
3.	High entrepreneurial brhaviour	28	28
	Total	100	100

Most of the women belong to medium to high experience level, medium to high mass media exposure, medium to high extension participation which leads to medium to high level of entrepreneurial behavior. Findings are in line with Ilma Siddiqui (2022).

Future Scope:

The study on entrepreneurial behavior among rural women in the dairy sector presents several avenues for future research and practical implications. Firstly, further investigation could delve deeper into understanding the specific challenges and barriers faced by rural women entrepreneurs in the dairy sector, such as access to finance, market linkages and technological advancements. This could inform the development of targeted support mechanisms and policy interventions to address these challenges effectively. Secondly, longitudinal studies tracking the progress and outcomes of rural women entrepreneurs over time could provide valuable insights into the sustainability and long-term impact of their entrepreneurial ventures. Understanding the factors contributing to the success and resilience of these ventures would enable the design of more effective capacity-building programs and interventions.

CONCLUSION

In conclusion, the study underscores the multifaceted nature of rural women's entrepreneurship in the dairy sector, influenced by demographic, socio-economic and environmental factors.The analysis reveals that 44% of rural women engaged in dairy farming fall within the middle-age category, indicating experienced individuals driving entrepreneurial activities. Education-wise, 36% have secondary education, showcasing the impact of educational initiatives on empowerment. Occupation diversification is evident, with 43% combining dairy farming with private jobs, 32% with agriculture and 25% with government employment. Nuclear families (61%) dominate, fostering autonomy and entrepreneurial drive, while 60% belong to medium-sized families, balancing responsibilities and opportunities. Extension participation (64%) and mass media exposure (89%) are moderate, enriching entrepreneurial behavior. These findings highlight the nuanced socio-economic landscape shaping rural women's entrepreneurship in dairying, emphasizing the need for tailored support mechanisms to foster sustainable development and gender empowerment in rural economies.

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DETERMINATION OF RAW MILK AS INFLUENCED BY DIFFERENT MILKING TIME ON BACTERIAL QUALITY OF GOAT, COW, AND BUFFALO ON MORNING AND EVENING MILKING INTERVAL

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ABSTRACT

The present investigation entitled "Determination of raw milk as influenced by different milking time on bacterial quality of Goat, cow and bufallo on Morning and evening milking interval" was carried out during March- May 2023 at the Livestock Production and Management (Unit), Department of Natural resource management (NRM), Faculty of Agriculture,Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot – Satna (Madhya Pradesh), to the study bacterial qualities of raw milk of Goat,cow and buffalo. The results of the investigation regarding the bacterial qualities of milk of Goat, cow and buffalo have been presented in this chapter with the help of tables and graphs. The study has been divided into the following sub- headings. Protein (%),Specific gravity (cc), Fat (%), Lactose (%),Ash (%),Total solid (%), Water (%), Solid not fat (SNF) (%), Acidity (%)In view of the findings and results presented above, it may be concluded that the bacterial quality of milk of Evening was superior to morning milk, due to higher protein. Specific gravity, fat content, lactose, total solid and solid not fat and lower ash ,Acidity, and water content in morning milk.

INTRODUCTION

Milk is sterile during secretion from healthy animals but the components that are foreign to it enter the milk in the udder or during or after milking as well as any changes occurring in the milk are often detrimental to its quality (Waltsra *et al.,*1999).Once, the milk comes outside the udder, microbial contamination may occur due to normal handling procedures and in between milking, teats may become soiled with dung, mud and bedding materials. Number and type of microorganisms vary according to type and amount of soil materials (Gierl and Putz,1992).

Goats are traditional farm animals in the Mediterranean basin, with five countries (Greece, Spain, France, Italy and Portugal) concentrating 97% of the EU goat population and 97% of its goat milk production. Spain is second in goat population (with 2,873,000 head in the year 2000) (FAO, 2000), Milk and other dairy products from cows, goats, and sheep are important components of the people diet. Milk do have distinct physical, chemical and

biological characteristics and its colour, odour, taste, consistency, freezing point (-0.55°C), pH (6.6) and specific gravity (1,032) are characteristics that remain particularly constant (Lues, J.F.R. *et al*., 2010) The bacterial contamination of milk not only reduces the nutritional quality but also consumption of such milk threatens health of the society (Nanu, E., *et al*., 2007). Advanced methods should be used for the analysis, monitoring, production and processing of milk. Fresh milk considered as a complete diet because it contains essential nutrients such as fat, protein, lactose, vitamins and minerals in balanced ratio compared to other foods (Shojaei and Yadollahi, 2008). Milk fat is different from other animal fats in that contains many more types of fatty acids. Fat helps in the proper metabolism of sugars and acts as a carrier of the fat-soluble vitamins (E, D, A and K). Milk protein is essential for formation of new tissues, repair of broken-down tissue and overall development of the body system (Islam *et al*., 2008). Iraqi sheep including Awassi, are mainly raised for the purpose of producing meat, milk and wool, and represent 50-60% of the Iraqi sheep which spread in the northern and middle areas of Iraq and considered one of the most important agriculture animals that are able to eat pastures and field residues and provide man with milk and meat (Al-Maiyah and Kadhim 2016 and Al-Sabea *et al*., 2020). Friesian cows are considered one of the most important purebred breeds of milk that entered Iraq due to its high production of milk and the length of its production season and the pace of adaptation to new environmental conditions and the possibility of mating with local livestock and improve (Salim and Salman 2020). Cattle and buffaloes provide direct cash income and are living bank for marginal farmers (Nakao, 2005). To target the export market the quality of milk is to be standardized and pricing should be based on milk quality and products should be diversified so that they suit the export market.

However, hygienic and quality regulations for production and distribution of milk are more relaxed in Nepal, and are not subject to specific microbiological standards in a legalsense. Gaps and deficiencies in such standards are to be identified and made compatible with World Trade Organzation (WTO) and South Asia Free Trade Agreement (SAFTA), which have potentially open markets in the South Asian Region. Nepal will have to compete aggressively on price along with quality. In Nepal, the formal markets for collection of raw milk produced by farmers are public sector dairy viz. the Dairy Development Cooperation (DDC), private dairies and the farmers" cooperatives, either the milk producers" cooperatives or milk producers" cooperative unions. Informal market for selling milk to the urban consumers by the producer farmers directly or through tea shops is also significant.

Chitwan is a leading dairy pocket area of the country. Of the 902,286 milking cows and 1,050,977 milking buffaloes in the country (MOAC, 2006), Chitwan houses 20,697 milking cows and 39,217 milking buffaloes (DLSO, 2006). Dairying can be one of the major components for addressing poverty alleviation in the country (HMG/TLDP, 2002). Livestock have been playing an important role in farm economy of rural households. It alone contributes 47.3%, 35.7% and 20% of the total agricultural income in the mountains, hills and the Terai, respectively (Tulachan and Neupane, 2009).

MATERIALS AND METHODS

The present experiment was "Determination of raw milk as influenced by different milking on time bacterial quality of Goat, cow and buffalo on Morning and evening milking interval" was carried out at the period of experiment was one month (May, 2023). Milk was collected at the Buffalo milk Bhalla dairy farm satna and Cow, goat milk Mini Dairy Farm Rajola. Analysed

Livestock Production and Management (Unit), Department of Natural resource management (NRM), Faculty of Agriculture,Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot – Satna (Madhya Pradesh).

Collection of milk samples:-

The objective was to find out the comparative bacterial qualities of raw milk of goat and sheep for three animal each viz. Goat, cow and buffalo cow for ten days as replication different parameter were subject to statistical analysis applying the technique of analysis of variance (f-test) the most widely used method for determining protein content by kjeldahi method for nitrogen determination since nitrogen is a characteristic can be finding.

Statistical Analysis of Data:

Organoleptic tests were performed by a panel of expert judges, Department of NRM through visually, nasally and lingually to evaluate the color, flavor, texture and appearance of collected raw milk samples. Specific gravity was determined using Quevenne's lactometer, cylinder and floating Dairy thermometer according to the procedure described by Agrawal and Sharma (1961). Acidity test (%) was performed by titrating milk samples with 0.1N NaOH solutions according to the method described by Agrawal and Sharma (1961). Fat test (%) was done according to Gerber Fat Test method and protein test (%) was performed by formal titration method according to Horwitz (1975). Total solids (TS) and solids-not-fat (SNF) (%) were calculated by mathematical formula of Eckles *et al.,* (1951). Ash content (%) was determined by evaporation method and lactose content (%) was determined by calculation method. Total viable count (cfu/ml) and coliform count (cfu/ml) were determined as per recommended by the American Public Health Association, 1960.

RESULTS AND DISCUSSION

(1) Protein:-

Table 1.0 and fig. 1.0 furnish the data on protein percentage in raw milk of cow. The results obtained showed that Morning and Evening registered mean protein percentage as 3.678, 3.42 , 3.819   (overall 3.639) and 3.837, 3.899, 3.98 (overall 3.905), respectively. The difference in the values due to animals was significant. Due to replication, the differences was non- significant. The protein percentage was higher in evening milk in comparison to morning milk.

Table - 1.0 : Protein (%) in Morning and Evening milk

| Replication		Morning				Evening			
		Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R$_1$		3.60	3.41	3.79	3.60	4.23	3.92	3.96	3.88
R$_2$		3.69	3.43	3.79	3.64	3.84	3.87	3.94	3.88
R$_3$		3.80	3.37	3.81	3.66	3.96	3.85	3.97	3.93
R$_4$		3.65	3.45	3.80	3.63	3.81	3.93	3.96	3.90
R$_5$		3.68	3.43	3.72	3.61	3.85	3.94	3.88	3.89
R$_6$		3.64	3.48	3.80	3.64	3.78	3.91	3.94	3.88
R$_7$		3.67	3.35	3.84	3.62	3.85	3.89	4.02	3.92
R$_8$		3.69	3.46	3.91	3.69	3.84	3.91	4.06	3.94
R$_9$		3.65	3.43	3.91	3.66	3.81	3.91	4.07	3.93
R$_{10}$		3.71	3.39	3.85	3.65	3.86	3.86	4.00	3.91
	Max	**3.80**	**3.48**	**3.91**	**3.69**	**3.96**	**3.94**	**4.07**	**3.94**
	Min	**3.60**	**3.35**	**3.72**	**3.60**	**4.23**	**3.85**	**3.88**	**3.88**
Range	Mean	**3.678**	**3.42**	**3.819**	**3.639**	**3.837**	**3.899**	**3.98**	**3.905**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		NS	2.103	4.419		NS	0.02	0.05	
Cow		NS	3.840	8.068		S	0.04	0.09	
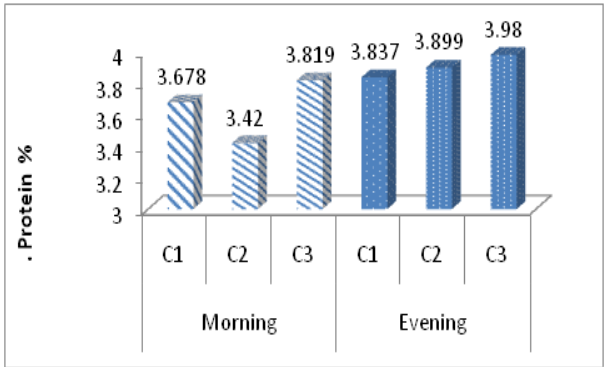
Fig : 1.0 Protein (%) in Morning and Evening Milk
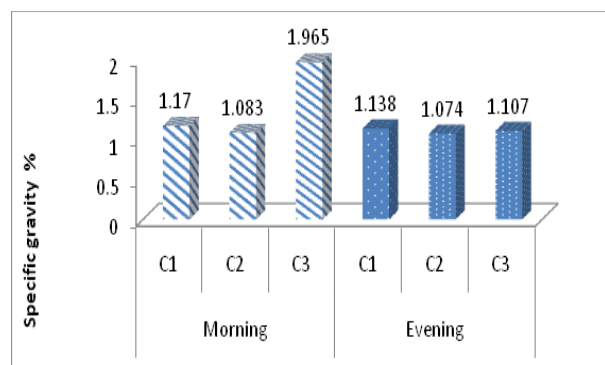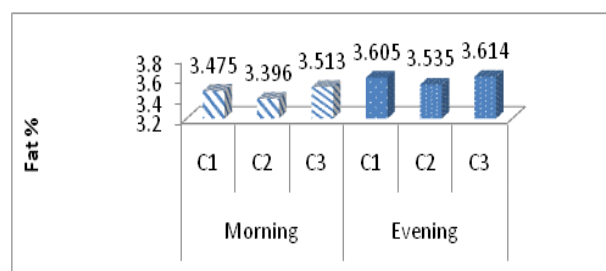
(2) Specific Gravity:-

Table 2.0 and fig. 2.0 furnish the data on specific gravity percentage in raw milk of Morning

and Evening. The results obtained showed that Morning and Evening registered mean specific gravity percentage as 1.17,1.083, and 1.965 (overall 1.406) and 1.138, 1.074 and 1.107 (overall 1.106), respectively. The difference in the values due to animals was significant. Due to replication, the differences was non –significant in Morning and Evening milk . Specific gravity percentage was higher in morning milk in comparison to evening milk.

Table - 2.0 :-Specific gravity (cc) in Morning and Evening milk

Replication	Morning				Evening			
	Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1	1.19	1.09	1.97	1.42	1.16	1.07	1.11	1.11
R_2	1.15	1.07	1.96	1.39	1.12	1.09	1.10	1.10
R_3	1.17	1.10	1.97	1.41	1.14	1.09	1.12	1.12
R_4	1.17	1.07	1.98	1.41	1.14	1.06	1.12	1.11
R_5	1.17	1.08	1.97	1.41	1.14	1.05	1.13	1.11
R_6	1.15	1.07	1.96	1.39	1.12	1.09	1.09	1.10
R_7	1.21	1.10	2.00	1.44	1.18	1.05	1.14	1.12
R_8	1.16	1.07	1.95	1.39	1.13	1.08	1.09	1.10
R_9	1.17	1.09	1.97	1.41	1.14	1.08	1.11	1.11
R_{10}	1.16	1.09	1.95	1.40	1.13	1.09	1.09	1.10
Range Max	1.21	1.10	2.00	1.44	1.18	1.09	1.14	1.12
Min	1.15	1.07	1.95	1.39	1.12	1.05	1.09	1.10
Mean	1.17	1.083	1.965	1.406	1.138	1.074	1.107	1.106
	Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication	NS	0.844	1.773		NS	0.01	0.02	
Cow	NS	1.540	3.236		S	0.02	0.03	

Fig : 2.0 Specific gravity (%)in Morning and Evening Milk

(3) Fat:-

Table 3.0 and fig. 3.0 furnish the data on fat percentage in raw milk of Morning and Evening .

The results obtained showed that Morning and Evening registered mean fat percentage as 3.475, 3.396, 3.513 (overall 3.461) and 3.605, 3.535, 3.614 (overall 3.585), respectively. The difference in the values due to animals was significant. Due to replication, the differences was non- significant in both , Morning and Evening milk . fat percentage was higher in evening milk in comparison to morning milk.

Table - 3.0: Fat (%)in Morning and Evening milk

Replication	Morning				Evening			
	Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1	3.08	2.12	2.91	2.70	3.22	2.24	3.03	2.83
R_2	3.66	2.71	3.23	3.20	3.78	2.81	3.32	3.30
R_3	3.23	3.06	3.44	3.24	3.36	3.17	3.54	3.36
R_4	3.40	3.52	3.51	3.48	3.53	3.63	3.61	3.59
R_5	3.21	3.48	3.42	3.37	3.35	3.60	3.53	3.49
R_6	3.16	3.34	3.40	3.30	3.28	3.44	3.49	3.40
R_7	3.11	3.40	3.56	3.36	3.26	3.53	3.68	3.49
R_8	4.16	4.23	3.90	3.94	4.28	3.87	3.99	4.05
R_9	3.87	4.16	4.04	4.02	4.00	4.47	4.14	4.20
R_{10}	3.87	4.40	3.74	4.00	4.00	4.61	3.84	4.15
Range Max	4.16	4.40	4.04	4.02	4.28	4.61	4.14	4.20
Min	3.08	2.12	2.91	2.70	3.22	2.24	3.03	2.83
Mean	3.475	3.396	3.513	3.461	3.605	3.535	3.614	3.585
	Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication	NS	2.003	4.208		S	0.14	0.29	
Cow	NS	3.657	7.683		NS	0.25	0.53	

Fig : 3.0 Fat (%) in Morning and Evening Milk

(4) Lactose :-

Table 4.0 and fig. 4.0 presents the data on lactose percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean lactose percentage as 4.621, 4.547, 4.542 (overall 4.570) and 4.975, 4.931, 4.767 (overall 4.891), respectively. The difference in the values due to animals as well as due to replication were significant.Higher lactose content was found in evening milk.

Table - 4.0 : Lactose (%) in Morning & Evening milk

Replication	Morning				Evening			
	Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1	4.48	4.45	4.43	4.45	4.95	4.85	4.83	4.88
R_2	4.61	4.58	4.56	4.58	5.03	5.03	4.81	4.95
R_3	4.62	4.46	4.48	4.52	5.04	4.96	4.82	4.94
R_4	4.72	4.61	4.68	4.67	4.99	4.96	4.87	4.94
R_5	4.58	4.55	4.53	4.55	5.05	5.00	4.93	4.99
R_6	4.66	4.63	4.56	4.62	4.98	4.98	4.86	4.94
R_7	4.74	4.64	4.71	4.70	5.06	4.99	4.74	4.93
R_8	4.51	4.47	4.42	4.47	4.83	4.82	4.71	4.79
R_9	4.67	4.56	4.53	4.59	4.99	4.91	4.41	4.77
R_{10}	4.62	4.52	4.53	4.56	4.84	4.82	4.72	4.79
Range Max	4.74	4.64	4.71	4.70	5.06	5.03	4.93	4.99
Min	4.48	4.45	4.42	4.45	4.83	4.82	4.41	4.77
Mean	4.621	4.547	4.542	4.570	4.975	4.931	4.767	4.891

	Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication	NS	2.639	5.544		S	0.04	0.08	
Cow	NS	4.818	10.121		S	0.07	0.14	
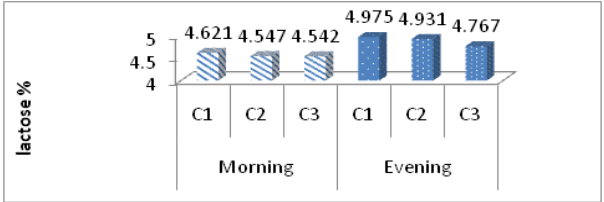
Fig 4.0 : Lactose (%) in Morning and Evening Milk

(5) Ash :-

Table 5.0 and fig. 5.0 furnish the data on ash percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean ash percentage as 0.747, 0.753, 0.746 (overall 0.748) and 0.740, 0.702 , 0.823 (overall 0.755), respectively. The difference in the values due to three animal each as well as due to replication were significant. Ash percentage was lower in morning milk in comparison to evening milk.

Table - 5.0: Ash (%) in Morning and Evening milk

Replication	Morning				Evening			
	Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1	0.74	0.72	0.76	0.74	0.75	0.69	0.83	0.76
R_2	0.72	0.74	0.72	0.73	0.73	0.73	0.81	0.75
R_3	0.73	0.76	0.72	0.74	0.73	0.68	0.83	0.75
R_4	0.75	0.76	0.78	0.76	0.72	0.67	0.78	0.72
R_5	0.76	0.73	0.75	0.75	0.76	0.71	0.86	0.78
R_6	0.73	0.79	0.75	0.76	0.73	0.72	0.81	0.75
R_7	0.74	0.71	0.72	0.72	0.77	0.70	0.86	0.78
R_8	0.78	0.81	0.80	0.80	0.73	0.71	0.82	0.75
R_9	0.80	0.79	0.78	0.79	0.74	0.70	0.83	0.76
R_{10}	0.72	0.72	0.71	0.72	0.75	0.72	0.83	0.76
Range Max	0.80	0.81	0.80	0.80	0.77	0.73	0.86	0.78
Min	0.72	0.71	0.71	0.72	0.72	0.67	0.78	0.72
Mean	0.747	0.753	0.746	0.748	0.740	0.702	0.823	0.755

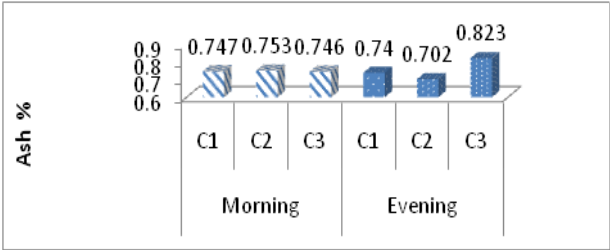|	Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication	NS	0.432	0.909		S	0.01	0.01	
Cow	NS	0.790	1.659		S	0.01	0.02	

Fig : 5.0 Ash (%) in   Morning and Evening Milk

(6) Total Solid:-

Table 6.0 and Fig 6.0 The data on total solid percentage in raw milk of Morning and Evening is presented in. The results contained in the Table showed that Morning and Evening registered mean total solid percentage as 12.606, 12.449 and 12.627 (overall 12.560) and 12.613, 12.455 and 12.675 (overall 12.581) respectively .The difference in these values to animals was found significant , whereas due to replication , the differences were non- significant. Total solid percentage was higher in evening milk in comparison to morning milk.

Table - 6.0 : Total solids (%) in Morning and Evening milk

Replication	Morning				Evening			
	Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1	12.35	12.27	12.64	12.42	12.33	12.27	12.58	12.39
R_2	12.51	12.44	11.52	12.16	12.51	12.42	12.44	12.46
R_3	12.63	12.36	13.10	12.70	12.64	12.35	13.06	12.68
R_4	13.05	12.87	13.00	12.97	13.06	12.88	13.06	13.00
R_5	12.61	12.33	12.75	12.56	12.63	12.33	12.69	12.55
R_6	12.52	12.36	12.55	12.48	12.52	12.34	12.47	12.44
R_7	13.46	13.14	13.58	13.39	13.50	13.17	13.53	13.40
R_8	12.37	12.27	12.48	12.37	12.37	12.25	12.40	12.34
R_9	12.28	12.12	12.34	12.25	12.29	12.23	12.27	12.26
R_{10}	12.28	12.33	12.34	12.32	12.29	12.32	12.27	12.29
Range Max	13.46	13.14	13.58	13.39	13.50	13.17	13.53	13.40
Min	12.28	12.12	11.52	12.16	12.29	12.23	12.27	12.26
Mean	12.606	12.449	12.627	12.560	12.613	12.455	12.675	12.581

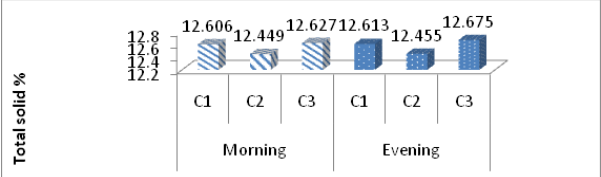|	Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication	NS	7.253	15.238		S	0.05	0.11	
Cow	NS	13.242	27.821		S	0.10	0.21	

Fig : 6.0 Total solid (%) in   Morning and Evening Milk

(7) Water:-

Table 7.0 and Fig 7.0 The data on water percentage in raw milk of Morning and Evening. The results obtained showed that Morning and Evening registered mean water percentage as 87.540, 87.661, 87.413 (overall 87.538) and 87.549, 87.651, 87.344 (overall 87.515), respectively. The difference in the values due to animals has been found significant but due to replication, the result was non-significant. Water percentage was lower in evening milk.

Table 7.0 Water (%) in Morning and Evening milk

Replication		Morning				Evening			
		Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1		87.85	87.83	87.54	87.74	87.87	87.83	87.48	87.73
R_2		87.61	87.72	87.62	87.65	87.61	87.70	87.54	87.61
R_3		87.51	87.76	87.03	87.43	87.52	87.75	86.96	87.41
R_4		87.09	87.23	87.03	87.12	87.10	87.22	86.96	87.09
R_5		87.55	87.77	87.43	87.58	87.57	87.77	87.37	87.57
R_6		87.60	87.80	87.59	87.66	87.60	87.78	87.51	87.63
R_7		86.72	86.94	86.62	86.76	86.75	86.95	86.57	86.76
R_8		87.75	87.87	87.66	87.76	87.75	87.85	87.58	87.73
R_9		87.86	87.88	87.82	87.85	87.87	87.87	87.75	87.83
R_{10}		87.86	87.81	87.82	87.83	87.87	87.80	87.75	87.80
Range	Max	87.86	87.88	87.82	87.85	87.87	87.87	87.75	87.83
	Min	86.72	86.94	86.62	86.76	86.75	86.95	86.57	86.76
	Mean	87.540	87.661	87.413	87.538	87.549	87.651	87.344	87.515
		Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication		NS	50.540	106.181		S	0.05	0.11	
Cow		NS	92.274	193.860		S	0.09	0.19	
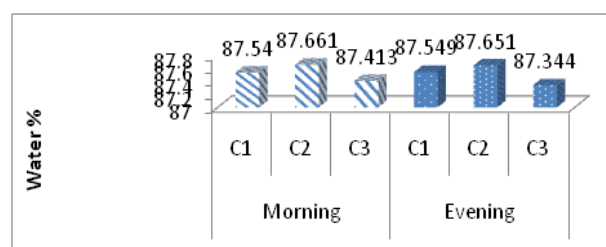
Fig : 7.0 Water (%) in Morning and Evening Milk

(8). Solid not fat (SNF):-

Table 8.0 and fig. 8.0 presents the data on solid not fat percentage in raw milk of Morning and Evening. The results presented in the Table showed that Morning and Evening registered mean

SNF percentage as 8.38, 8.41 ,8.40 (overall 8.40) and 8.39 ,8.40, 8.34 (overall 8.38), respectively. The differences in these values due to animals were significant, whereas due to replication the differences were non – significant. SNF content in evening milk was higher than that in Morning milk.

Table - 8.0 : Solid not Fat (%) SNF in Morning and Evening milk

Replication		Morning				Evening			
		Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R_1		8.65	8.48	8.47	8.53	8.67	8.49	8.51	8.55
R_2		8.09	8.14	7.52	7.92	8.09	8.12	7.44	7.88
R_3		8.45	8.64	8.47	8.52	8.46	8.63	8.40	8.50
R_4		8.55	8.52	8.56	8.54	8.56	8.51	8.49	8.52
R_5		8.31	8.30	8.23	8.28	8.33	8.30	8.17	8.27
R_6		8.69	8.26	8.41	8.45	8.69	8.24	8.33	8.42
R_7		8.59	8.55	8.85	8.66	8.62	8.56	8.80	8.66
R_8		8.17	8.57	8.82	8.52	8.18	8.55	8.74	8.49
R_9		7.97	8.34	8.53	8.28	7.98	8.33	8.46	8.26
R_{10}		8.31	8.33	8.19	8.28	8.32	8.32	8.12	8.25
Range	Max	8.69	8.64	8.85	8.66	8.69	8.63	8.80	8.66
	Min	7.97	8.14	7.52	7.92	7.98	8.12	7.44	7.88
	Mean	8.38	8.41	8.40	8.40	8.39	8.40	8.34	8.38
		Result	S. Ed. (±)	C.D. at 5%		Result	S. Ed. (±)	C.D. at 5%	
Replication		NS	4.850	10.188		S	0.09	0.20	
Cow		NS	8.854	18.601		NS	0.17	0.36	
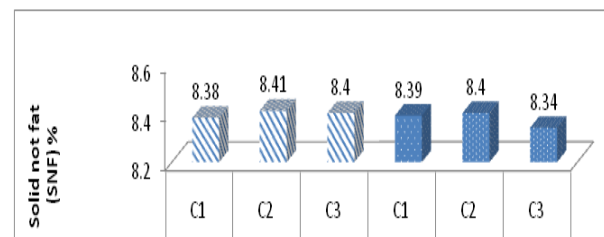
Fig : 8.0 Solid not fat (SNF) (%) in Morning and Evening Milk

(9) Per cent Acidity (%)

Table 9.0 and fig. 9.0 presents the data on acidity percentage in raw milk of Morning and Evening. The results presented in the Table showed that Morning and Evening registered mean SNF percentage as 0.218, 0.217 ,0223 (overall 0.219) and 0.180 ,0.165, 0.181 (overall 0.175), respectively. The differences in these values due to animals were non-significant, whereas due to replication the differences were non – significant. Acidity percent was lower in evening milk.

Table - 9.0 : Acidity % in Morning and Evening milk

Replication		Morning				Evening			
		Goat	Cow	Buffalo	Mean	Goat	Cow	Buffalo	Mean
R$_1$		8.65	8.48	8.47	8.53	8.67	8.49	8.51	8.55
R$_2$		8.09	8.14	7.52	7.92	8.09	8.12	7.44	7.88
R$_3$		8.45	8.64	8.47	8.52	8.46	8.63	8.40	8.50
R$_4$		8.55	8.52	8.56	8.54	8.56	8.51	8.49	8.52
R$_5$		8.31	8.30	8.23	8.28	8.33	8.30	8.17	8.27
R$_6$		8.69	8.26	8.41	8.45	8.69	8.24	8.33	8.42
R$_7$		8.59	8.55	8.85	8.66	8.62	8.56	8.80	8.66
R$_8$		8.17	8.57	8.82	8.52	8.18	8.55	8.74	8.49
R$_9$		7.97	8.34	8.53	8.28	7.98	8.33	8.46	8.26
R$_{10}$		8.31	8.33	8.19	8.28	8.32	8.32	8.12	8.25
	Max	**8.69**	**8.64**	**8.85**	**8.66**	**8.69**	**8.63**	**8.80**	**8.66**
	Min	**7.97**	**8.14**	**7.52**	**7.92**	**7.98**	**8.12**	**7.44**	**7.88**
Range	Mean	**8.38**	**8.41**	**8.40**	**8.40**	**8.39**	**8.41**	**8.34**	**8.38**
		Result	S. Ed. (±)	C.D. at 5%		**Result**	S. Ed. (±)	C.D. at 5%	
Replication		NS	4.850	10.188		S	0.09	0.20	
Cow		NS	8.854	18.601		NS	0.17	0.36	

Fig. 9.0 Acidity (%) in Morning and Evening Milk

CONCLUSION

In view of the findings and results presented above, it may be concluded that the bacterial quality of milk of Evening was superior to morning milk, due to higher protein. Specific gravity, fat content, lactose, total solid and SNF and lower Ash , Acidity and water content in morning milk.

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EXPLORING CONSUMER BRAND PREFERENCES FOR PACKAGED FOOD PRODUCTS IN LUCKNOW, UTTAR PRADESH: A MARKET ANALYSIS

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ABSTRACT

A study conducted in Lucknow City aimed to identify the top-selling branded packaged food products in the local market. Utilizing both primary and secondary data sources, the research employed a questionnaire-based approach, gathering insights from customers across Lucknow City. The sample size consisted of 100 respondents, with a particular focus on children. The analysis utilized the Garrett ranking technique to assess the data. The findings revealed that DFM Foods' CRAX Corn Rings emerged as the most preferred product among children, occupying the top position. This was followed by Cadbury's Oreo biscuits, Pepsico's Lays, ITC Limited's Bingo, Bikhaji Bhujia, Haldiram's Namkeen, Lotte Choco Pie, Kellogg's Chocos, PepsiCo's Kurkure, and Britannia's Fruit Cake, in respective order of preference.

INTRODUCTION

Packaging which used to be a mere necessity few decades back has now turned into an art and a science. While it primarily involves enclosing or protecting products for storage, distribution, sale, and use, today attractive packaging helps to draw customers towards the product. . It also refers to the process of design, evaluation, and production of packages. While appropriate packaging is important to maintain the basic attributes of food (temperature, color, taste, texture, etc.), maintaining food safety is an important function of packaging. There are as many answers to this question as the number of types of food packets! While a particular 'Mil-grade' type of tough food packaging developed during the World War - II, when food got destroyed due to poor packaging; it was in the 1930s that single use cone cups, plates etc. were widely used to feed workers on the remote dams, bridges and roads of the Works Progress Administration in USA, to cut cost and for ease of transport. It was Dr. Samuel J. Crumbinea public health officer in Kansas, in 1908, who while on a train witnessed one of his TB patients taking a drink of water from a common dipper and water bucket (a publicly shared way of drinking water) in the car. Right behind his patient was a young girl who drank from the same dipper and bucket. This

inspired him to launch a crusade to ban publicly shared or common utensils in public places (Gupta and Dudeja, 2017). Marketers design their marketing activities in a way that attracts consumers. Children in particular have an immature mind with regard to purchases, which cannot be discreet about the nature of content through mass media advertisements. Most of the people in the said category immediately form an opinion about what they see and mostly in favour of it. It is a quick decision domain where these youths experience a high degree of exposure to mass media. Children are thus easy targets for advertisers. Children have a tendency to be attracted to information shown on TV or other media. Children too easily fall prey to their favorite advertisements being circulated on the media. Marketers see potential markets in children. They consider children not only as the primary market but as the dominant and future market (Thaper*et al.*, 2021). In 2022, the market size of the packaged food sector was 2.7 billion U.S. dollars in India. The size of the packaged food market is likely to reach about 3.4 billion U.S. dollars by 2027. Moreover, dairy products occupied the country's largest packaged food market share (www.statista.com).The India Packaging Market size is estimated at USD 84.37 billion in 2024, and is expected to reach USD 142.56 billion by 2029, growing at a CAGR of 11.06% during the forecast period (2024-2029) (www.mordorintelligence.com).

MATERIALS AND METHODS

The research methodology employed in this study involved the administration of a questionnaire to customers residing in Lucknow city. Both primary and secondary data sources were utilized, with primary data obtained directly from customers and secondary data derived from journals, magazines, and advertisements. The sample size comprised 100 customers.Data analysis was conducted using the Garrett ranking technique following data collection.

Table - 1: Preference towards the brands of packaged food products in the market

S. No.	Products (Brand)	Total Score	Mean Score	Rank
1	Haldiram'sHaldirams Namkeen	5127	51.27	VI
2	Britannia's Fruit Cake	2981	29.81	X
3	DFM Foods' CRAX Corn Rings	7884	78.84	I
4	Cadbury's Oreo Biscuits	6923	69.23	II
5	Lotte Choco Pie	43.23	43.23	VII
6	BikajiBhujia	5668	56.68	V
7	Kellogg's Chocos	3246	32.46	VIII
8	Pepsico's Lays	6457	64.57	III
9	ITC Limited's Bingo	61.12	61.12	IV
10	PepsiCo's Kurkure	3050	30.50	IX

RESULTS AND DISCUSSION

Mean Score

The table 1 and figure 1 (a) presents data on various packaged food products along with their respective total scores, mean scores, and ranks based on the Garrett ranking technique. DFM Foods' CRAX Corn Rings emerges as the most preferred product, securing the top position with a total score of 7884 and a mean score of 78.84. Cadbury's Oreo Biscuits follow closely behind, ranking second with a total score of 6923 and a mean score of 69.23, while Pepsico's Lays holds the third position with a total score of 6457 and a mean score of 64.57. BikajiBhujia, with a total score of 5668 and a mean score of 56.68, takes the fifth position, while Haldiram'sHaldirams Namkeen and Britannia's Fruit Cake rank sixth and tenth, respectively. Lotte Choco Pie and Kellogg's Chocos secure the seventh and eighth positions, with mean scores provided but without total scores. ITC Limited's Bingo and PepsiCo's Kurkure round out the rankings at fourth and ninth places, respectively. These rankings reflect the preferences of consumers in the market, as analyzed through the Garrett ranking technique.

CONCLUSION

The research conducted aimed to identify the preferences among children for various packaged food products available in the Lucknow market. Through a comprehensive analysis that incorporated both primary and secondary data, a clear picture emerged regarding the hierarchy of preferences among the surveyed products.

DFM Foods' CRAX Corn Rings emerged as the standout favorite, securing the top position in children's preferences. This could be attributed to various factors such as taste, packaging appeal, brand recognition, and marketing strategies targeted towards children. The popularity of Cadbury's Oreo biscuits and Pepsico's Lays, which followed closely behind, highlights the significance of well-established brands in capturing the attention and loyalty of young consumers.ITC Limited's Bingo, BikhajiBhujia,and Haldiram'sHaldirams Namkeen also featured prominently in the ranking, indicating a preference for savory snack options among children in Lucknow. Lotte Choco Pie and Kellogg's Chocos, known for their sweet and chocolatey flavors, secured positions in the middle tier of preferences, reflecting the diverse tastes and preferences among children.PepsiCo's Kurkure and Britannia's Fruit Cake, while still part of the ranking, occupied lower positions compared to other products. This may indicate a relatively lower level of appeal or market penetration among children in the Lucknow region.

Overall, the findings of the study underscore the importance of understanding consumer preferences, especially among younger demographics, in shaping marketing strategies and product development initiatives within the packaged food industry. By catering to the specific tastes, preferences, and purchasing behaviors of children in the market, brands can effectively differentiate themselves and gain a competitive edge in an increasingly crowded marketplace. Further research and analysis could delve deeper into the underlying factors driving children's preferences and inform

targeted marketing campaigns and product innovations tailored to meet the evolving needs and desires of young consumers in Lucknow and beyond.

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DRAGONFLIES AND DAMSELFLIES (INSECTA: ODONATA) DIVERSITY OF SANJAY-DUBRI NATIONAL PARK, SIDHI, MADHYA PRADESH

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ABSTRACT

Sanjay-Dubri National Park is located in Sidhi District and Singrauli district of Madhya Pradesh in India and is spread over an area of 466.7 Square kilometers. It is a part of the Sanjay Dubri Tiger Reserve, which is known for its rich and varied flora and fauna. The survey of the National park to explore the odonatefauna from the different localities, as no previous work is available on this group. The present study is based on the identification of collection of Odonata from different localities of Sanjay Dubri National Park during 2018-2021. A total 38 species belonging to 24 genera under 7 families and 2 suborders of order Odonata recorded from Sanjay Dubri National Park, Sidhi districts of Madhya Pradesh.

INTRODUCTION

Madhya Pradesh is land locked and second largest state by area situated in the center of India. The state is recognized as Tiger state of the country and largest forest areas with several famous biosphere reserves, national parks and wildlife sanctuaries spreads across the stateand unique and varied floral and faunal biodiversity. Sanjay Dubri National Park is situated in the Sidhi district of Madhya Pradesh. It is established in the year 23.09.1981. The total area of the National Park is 466.88 sq. km. It forms the part of Sanjay-Dubri Tiger Reserve which is known for its rich and varied flora and fauna comprising rare and endangered species.

Dragonflies and Damselflies (Odonates) are an ancient insect order with origins in theCarboniferous era about 250 million years ago(Grimaldi and Engel 2005; Tipleet al, 2022). They probably mark the first time that evolutionexperimented with the ability to hover in the air over an object of interest (Andrew *et al.* 2008).They are beautifully coloured, primarily aquatic in their pre-adult stages, and closely tied tofreshwater ecosystems such as rivers, streams, lakes, marshes, and rice fields. They are wellknown for their colourful bodies, enormous body size, and association with aquatic surroundings. Except for

Antarctica, all continents have odonates, with tropical forests having the highest species richness (Kalkman*et al*. 2008).Species are usuallyhighly specific to habitats, but some have adapted to using man-made water bodies (Tiple andChandra 2013).They are regarded as beneficial insects because they are carnivorous throughout their life,mostly feeding on smaller insects such as mosquitoes, termites, ants, mayflies, small moths etc.Many odonate species that live in forest and agroecosystems act as biocontrol agents and are essential for regulating pest populations. They are widely distributed in freshwater habitats like ponds, lakes, streams, rivers, canals, etc.and although some species roam widely and found far from their breeding sites. The presence ofdragonflies and damselflies are good indicators of freshwater ecosystem because they dependenton both aquatic and terrestrial habitats to maintain viable populations (Subramanian, *et al*., 2008;Tiple*et al*., 2012). The odonates larvae occupy a great diversity of aquatic habitats and formsignificant constituent of aquatic food webs involving many invertebrates, fishes and othervertebrates and serving as the dominant invertebrate predators of many aquatic insect larvae andas the prey of fish (Subramanian and Babu, 2020).

Some studies made by various workers on odonate diversity of different areas of Madhya Pradesh *viz*, National parks, Wild Life Sanctuaries, Biosphere Reserves, Conservation areas and Tiger Reserves. Mishra (2007) reported about 70 species of odonata from Madhya Pradesh.The documentation on odonate fauna of protected areas of Madhya Pradesh have been reported from Pench National Park and Satpura National Park (Ramakrishna *et al.,* 2006), Kanha National Park (Raju and Narayanan, 2008, Tiple*et al.,* 2011, Sahoo*et al.,* 2013), Bandhavgarh Tiger Reserve (Mishra, 2009), Pachmarhiand Achanakmar-

Amarakantak Biosphere Reserve (Prasad and Mishra, 2009; Tiple, 2012), VeeranganaDurgawati Wildlife Sanctuary (Talmale, 2012, 2016a) andSinghori Wildlife Sanctuary (Talmale, 2011, 2016b). Das *et al*. (2013) studied the odonates diversity of three Tiger Reserve, Pench, Kanha and Bandhavgarh. Recently, Talmale, (2022) reported 50 species of odonatafrom Nauradehi Wildlife Sanctuary.

Though, the diversity of Odonatahave been well documented from different National Park,Wildlife sanctuaries and Biosphere Reserves of Madhya Pradesh, no consolidated checklist ofOdonatesof SanjayDubri National Park and its surrounding areas is available and hence the present onewith an objective of exploring the diversity and abundance.

The present paper reports detailed entomological survey on the dragonflies and damselflies(Odonata) diversity in SanjayDubri National Park Sidhi district of Madhya Pradesh states.

MATERIALS AND METHODS
STUDY AREA

Sanjay DubriNational Park is situated in the Sidhi district of Madhya Pradesh. It is establishedin the year 23.09.1981. Total area of the National Park is 466.88 sq. km. It forms the part ofSanjay-Dubri Tiger Reserve which is known for its rich and varied flora and fauna comprisingrare and endangered species. The Sanjay National Park was erstwhile known as Guru GhadidasNational Park and it comprises of a number of rivers, rivulets and other perennial sources ofwater that supports rich biodiversity. Sanjay National Park is one of the most popular wildlifedestinations in Madhya Pradesh, visited by tourists, especially nature lovers from different partsof the country. This entire park is a moist deciduous forest with rich plantations of Sal andbamboo that makes for a perfect habitat for

animals like tiger, leopard, deer, sambar, wild boar, neelgai, chinkara, and more.

COLLECTION AND IDENTIFICATION

A detailed study and extensive collection and observation of odonates were made bydifferent survey parties of Zoological Survey of India, Central Zone Regional Centre, Jabalpurby using aerial sweep net in the selected localities of Sanjay DubriNational Park during 2018-2022.The collected individuals in the field were transferred into insect collection paper packs and werebrought to the laboratory of CZRC, where these were properly stretched, pinned, oven dried for72 hours at 60^0C, labeled, identified and preserved in insect collection boxes and kept in ModernInsect Storage Compactors. Identification of adult individuals was carried out usingidentification keys provided by Fraser 1933, 1934 & 1936.

All the materials were deposited in the National Zoological Collection, Zoological Survey of India, CZRC, Jabalpur, Madhya Pradesh.

The nomenclature followed here is after, Davies and Tobin (1984 & 1985), Tsuda (2000) and Subramanian and Babu (2017a).

Map of Sanjay Dubri National Park, Sidhi, Madhya Pradesh

RESULTS AND DISCUSSION

The present investigation, recorded a total of 38 odonatesspecies belonging 24 genera and 7 families, 6 superfamilies in two suborders. The family Libellulidae having the highest number of species 16 (42.10%) species followed by family Coenagrionidae10 (26.31%) species, Lestidae 4 (10.52%) species, Aeshnidae4 (10.52%) species, Platycnemididae 2 (5.26%) species, Chlorocyphidae and Gomphidae1 (2.63%) specieseach (Table 1, Fig 1). The suborder Anisoptera was abundant in comparison to Zygoptera, and found in all the water bodies that were sampled.

The detailed checklist of different odonatesspecies with their orders, superfamily, families and International Union for Conservation of Nature (IUCN) Red List of Threatened Species status is also provided. According to IUCN Red List Version 2021—22, all the dragonflies and damselflies are Least Concerned (LC).The Libellulidae family was dominant and encompasses 16 species, like *Brachythemiscontaminata*, *Crocothemisservilia*, *Bradinopygageminata, Trithemisfestiva, Diplacodestrivialis, Orthetrumsabina*, *Pantalafavescens* and *Tholymistllarga*. These species are commonly found in various habitats. The Coenagrionidae family was dominant and exhibited the highest recorded species count among the damselflies. *Ceriagrioncoromandelianum* and *Ischnurarubilio*was found most common species of damselflies in study area. The observed species were present in various water bodies, agricultural fields, and grasslands within the different localities of National park.

Table - 1 : Dragonflies and Damselflies of Sanjay-Dubri National Park, Sidhi, Madhya Pradesh

Sl.No.	Suborder/ Superfamily	Families	Species	IUCN Red List
1	(Damselflies) Zygoptera/ Lestoidea	Lestidae	*Lesteselatus*Hagen in Selys, 1862	LC
2			*Lestesthoracicus*Laidlaw, 1920	LC
3			*Lestesumbrinus*Selys, 1891	LC
4			*Lestesviridulus*Rambur, 1842	LC
5	Calopterygoidea	Chlorocyphidae	*Libellagolineatalineata*(Burm.,1839)	LC
6	Coenagrionidea	Coenagrionidae	*Agriocnemispygmaea*(Rambur, 1842)	LC
7			*Agriocnemissplendidissima*Laidlaw,1919	LC
8			*Amphiallagmaparvum*Selys, 1876	LC
9			*Ceriagrioncoromandelianum*(Fabricius, 1798)	LC
10			*Ischnurarubilio*Selys, 1876	LC
11			*Ischnuranursei*(Morton,1907)	LC
12			*Ischnurasenegalensis*(Rambur, 1842)	LC
13			*Pseudagrion decorum* (Rambur, 1842)	LC
14			*Pseudagrionmicrocephalum*(Rambur, 1842)	LC
15			*Pseudagrionrubriceps*Selys, 1876	LC
16		Platycnemididae	*Coperamarginipes*(Rambur, 1842)	LC
17			*Disparoneuraquadrimaculata*(Rambur,1842)	LC
18	(Dragonflies)/	Aeshnidae	*Anaxephippiger*(Burmeister, 1839)	LC
19			*Anaxguttatus*(Burmeister, 1839)	LC
20			*Anaximmaculifrons*Rambur, 1842	LC
21			*Gynacanthabayadera*Selys, 1891	LC
22	Gomphoidea	Gomphidae	*Ictinogomphusrapax*(Rambur, 1842)	LC
23	Libellulioidea	Libellulidae	*Acisomapanorpoidespanorpoides*Rambur, 1842	LC
24			*Brachythemiscontaminata*(Fabricius, 1793)	LC
25			*Bradinopygageminata*(Rambur, 1842)	LC
26			*Crocothemisserviliaservilia*(Drury, 1770)	LC
27			*Neurothemisfulvia*(Drury, 1773)	LC
28			*Orthetrumglaucum*(Brauer, 1865)	LC
29			*Orthetrumpruinosumneglectum*(Rambur, 1842)	LC
30			*Orthetrumsabinasabina*(Drury, 1770)	LC
31			*Orthetrumtaeniolatum*(Schneider, 1845)	LC
32			*Pantalaflavescens*(Fabricius, 1798)	LC
33			*Potamarcha congener* (Rambur, 1842).	LC
34			*Rhyothemisvariegatavariegata*(Linnaeus, 1763)	LC
35			*Tholymistillarga*(Fabricius, 1798)	LC
36			*Trameabasilarisburmeisteri*Kirbyi, 1889	LC
37			*Trithemis aurora* (Burmeister, 1839)	LC
38			*Trithemisfestiva*(Rambur, 1842)	LC

Fig 1: Dominance of species in different families
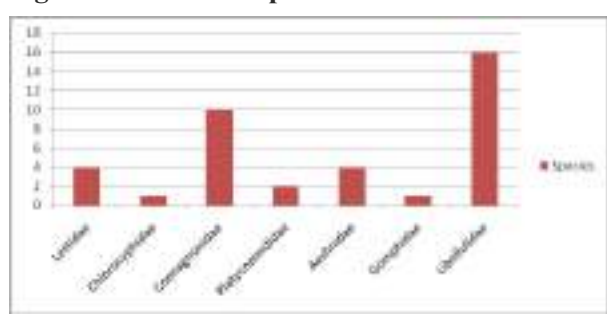
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STUDIES ON SOIL PARAMETERS UNDER POLYHOUSES HAVING ROOT-KNOT NEMATODE, MELOIDOGYNE SPP. AFFECTED CAPSICUM CROP IN LUCKNOW AREA OF UTTAR PRADESH

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ABSTRACT

Phytonematodes have emerged as one of the limiting factor in the successful production of vegetable crops under Polyhouse conditions. They are microscopic invertebrate animals often called as threadworms, eelworms or roundworms. However, *Meloidogyne spp.* spread under Polyhouse condition increases from 10 to 60% of the area because of the monoculturing and thus yield losses may go upto several folds under such conditions. Hence, investigations of different soil parameter studies on pH, Electrical conductivity, organic carbon, Available Nitrogen, Available Phosphorus and Available Potassium was undertaken under Polyhouse condition from root-knot affected Capsicum crop. Low to very high fertility status (N, P, K) was recorded. Moreover, Farmers are advised to use only balance fertilizers or nutrients under Polyhouse conditions.

INTRODUCTION

Protected cultivation of horticultural crops has gained popularity among farmers due to high productivity, better quality of produce and manifold increase in yield per unit area. This is an emerging technology for raising vegetable & ornamental crops under controlled environmental conditions. This is feasible in the tropical and subtropical climatic conditions of India for the cultivation of high value crops. Out of 525 ha area under greenhouses in India, 83 ha has been covered in the NE states maximum area being in Sikkim. Protected cultivation is being followed worldwide, Japan and China has maximum share of around 54000 and 48000 ha under green houses respectively. Several private seed production agencies have promoted greenhouse production of vegetables. The polyhouse technologies are being practiced in India in states of Kerala, Andhra Pradesh, Bangalore, West Bengal, Rajasthan, Gujarat and Northern Eastern regions. Now the protected cultivation is also spread in Chattisgarh, Tamil Nadu, Orissa, Bihar, etc. under mulches and pond reservoir. Himachal Pradesh government is promoting farming inside Polyhouses to improve the earning potential of farmers in the state especially during winters. High day time temperature and relative humidity within the greenhouses and low tunnels

along with poor plant hygienic conditions inside and outside greenhouses provide ideal conditions for the introduction and rapid multiplication of insects, fungal, viral, bacterial and diseases caused by plant-parasitic nematodes. This is useful to cultivate healthy nursery or plant material, hardening of tissue culture plant and floriculture.

Fig. 1 : Polyhouse view having Capsicum (*Capsicum annuum L.*) crop

Under Polyhouse conditions besides pests and diseases problems Phytonematodes have emerged as one of the limiting factor in the successful production of vegetable crops. (Dropkin, 1980) The problem of nematode after 3-4 crop increases due to build up of initial population in first crop and shortening of life cycle of nematode due to higher temperature. Phytonematodes are microscopic invertebrate animals often called as thread worms, eelworms or roundworms. They are distributed all over the world in different kinds of habitats and is found in nearly every biological niche that supports life. They cause severe losses to economically important crops like vegetables, etc. The degree of damage caused by nematodes depend upon population density of nematodes, susceptibility of the crop, environmental condition such as soil fertility, moisture and also presence of other pathogenic microorganisms which may interact with nematodes as they are known to cause disease complex in association with fungi, bacteria

and viruses. Crop losses due to nematodes appear in different forms. (Yeates, 2003) It may be loss in yield, deterioration in quality of product and the increase in cost of production, etc. The losses in our agriculture production due to plant-parasitic nematodes justify need for adopting their different management practices to check their population level of infestation under Polyhouse conditions. Moreover, *M. incognita* spreads under Polyhouse condition increases from 10 to 60 % of the area because of the mono-culturing and thus yield losses may go up to several folds under such environment.

Hence Survey was carried out in Lucknow area of Uttar Pradesh. I went to Raebareilly, Chanhat, Barabanki, Mohanlalganj, Malihabad, Kakori, Bakshi Ka Talab, Alamnagar, Juggnar, Gosainagar, Sikanderpur, Unnao, Sidhauli, Mahona, Rahimabad, Barabanki, Bhauli, Bani, Sisondi, Nigoha, Utrahtia, Kheri, Itaunja, Sitapur, etc. Finally few Polyhouses in Sitapur Road, Lucknow was having Capsicum crop raised in beds having nematode, fungus, bacteria, virus and insect problem. (Fig.1) Some plants were having thrips, aphids, mite problems, Downy mildew & others having leaf dropping problem. Few plants had root-knot infection and in some fungal infection was visible. They are raising three different types of Capsicum crop yielding red, green and yellow colour capsicum. On uprooting few plants, very small galls were seen of root-knot nematodes, *Meloidogyne spp*. However, nematode extraction was done by using Cobb Sieving and Decanting Technique. Second stage juveniles of root-knot nematode was found in the range of 2-3J_2/cc soil in Polyhouses. Thus I took the soil samples from different beds from all three colour Capsicum crop from various Polyhouses for estimation of different soil parameters studies i.e., pH, electrical conductivity (EC) of the soil, Organic carbon, Available nitrogen, available Phosphorus and

available Potassium. Soil testing is a useful tool in making site-specific fertilizer recommendation and will result in economic and environmental benefits. (Conklin, 2005)

MATERIALS AND METHODS

Soil samples (5) were drawn from two Polyhouses having Capsicum crop and analyzed for pH and electrical conductivity (EC) of the soil, Organic carbon, Available nitrogen, available phosphorus and available potassium. (Fig. 2) Analysis for pH and electrical conductivity (EC) of the soil : water (1:2) suspension was determined by potentio-metrically using pH electrode (Thermo Orion make) calibrated with pH buffer of 7.0 and 9.2 pH and EC by conductivity meter, Organic carbon determined by Walkley and Black method (Nelson and Sommers, 1996). Available nitrogen was analyzed by alkaline permanganate method (Subbaiah and Asija, 1956), available phosphorus by Olsen *et al*. (1954) and available potassium by ammonium acetate method (Hanway and Heidal, 1952) and data is further recorded.

Fig. 2 : Soil samples taken from Polyhouses having Capsicum crop.

RESULTS AND DISCUSSION

Plant-parasitic nematodes are in general, aerobic and originally aquatic organisms that require adequate moisture and aeration from adsorbed soil water films (moisture levels ranging between 40% and 60% of field capacity) (Dropkin, 1980; Kim, 2015). A variety of abiotic and biotic factors affect the establishment of nematode communities in soil. In agriculture, the proportion and diversity of nematodes are utilized to determine soil process rates (Yeates, 2003) and functions. Soil acidity has also been reported to affect nematode populations. Nematodes are reported to be one of the most important and widespread agricultural pests (Koenning *et al*., 1996). Physical and chemical soil parameters affect the activity of living organisms within the soil. Five major properties including temperature, moisture, water holding capacity of the soil as well as soil pH and electrical conductivity plays an important role in soil functioning, diversity and various soil factors are reportedly responsible for the distribution of soil nematodes (Castro *et al*., 1990).

It was observed in first year (Table 1) that in soil samples from Polyhouses having Capsicum crop High to Very High Fertility status (N, P, K) recorded. In two samples saline EC was found and in other three samples near to normal condition recorded. They are advised to use only balance fertilizers or nutrients. Moreover, after harvest of crop, condition require deep ploughing and flooding with good water in order to reduce the saline soil

Table – 1 Estimation of Soil samples for first year.

S. No.	Soil sample No.	Sample type	pH (1:2)	EC (1:2) (dS/m)	O.C. %	Available Nutrients (kg ha-1)			Remarks
						N	P	K	High (H) to very high (VH) in fertility status and use only balance fertilizers or nutrients. (M) = Medium
1.	5	Soil	6.89	1.395 saline	1.12 **H**	501 **M**	518 **VH**	855 **VH**	
2.	4	Soil	6.05	1.329	1.85 **VH**	689 **H**	324 **VH**	1291 **VH**	
3.	3	Soil	6.24	0.559 normal	1.02 **H**	464 **M**	343 **VH**	807 **VH**	
4.	2	Soil	5.89	0.66	1.53 **H**	501 **M**	135 **VH**	1472 **VH**	
5.	1	Soil	5.86	0.938	0.73 **M**	489 **M**	78 **VH**	711 **VH**	

condition and even suggested to apply lime material (CaCO$_3$) @ 02 t ha^{-1} in soil (samples 4 and 5) of Polyhouses.

Gade and Howare's (2017) study revealed that soil pH level was not associated with the proportion of nematodes. Additionally, no correlation was found between soil moisture and nematode diversity. Furthermore, a positive correlation was found between temperature and electrical conductivity and nematode diversity. Finally, a negative correlation was found between soil moisture, pH and proportion of nematodes but no correlation was found between soil moisture content and nematode diversity. It was reported that soil organic matter contents correlated with lower proportion of plant-parasitic nematodes thus suggesting that the addition of organic compounds is a way to suppress these parasites (Barros et al., 2017). However, soil OM contents were also positively correlated with free-living nematodes probably by favoring the growth of microbes (bacteria and fungi) which increased the nematode population (Berry et al., 2005). Therefore, soil OM affects the spatial soil distribution of nematodes (Cadet and Spaull, 2003). Organic matter (OM) constitutes fundamental soil component that serves as source of carbon and energy for plants and soil organisms and thus also affects root infestation by plant-parasitic nematodes.

The chemical characteristics of soil affect the density and diversity of soil organisms (Arnold et al., 2010) including the composition and structure of nematode communities (Cardoso et al., 2012). Additionally, soil type affects both the composition of nematode species in soil and how well the host plants can grow. Soil acidity has been found to be an important physicochemical factor in soil that affects soil physicochemical and biological properties and consequently plant growth and soil biota (Kabata-Pendias, 2000). Soil salinity and salt accumulation are other important factors that are both affected by weather changes, improper watering and plant fertilization.

Table – 2 : Estimation of Soil Samples for Second Year.

Soil Samples	EC (1:2) dSm^{-1}	pH (1:2)	O.C (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
1.	0.28	7.27	0.524	192.1	115.0	267.9
2.	0.31	6.86	0.407	173.7	106.5	165.3
3.	0.28	7.10	0.415	175.0	125.9	455.2
4.	0.29	7.07	0.202	141.7	88.4	236.1
5.	0.39	6.65	0.506	189.3	111.4	340.9
6.	0.23	7.05	0.429	177.1	86.0	233.9

Table – 3 : Fertility Rating of Nutrients for Different Categories

S. No.	Nutrient	Soil Test Rating Limit		
		Low	Medium	High
1.	Available nitrogen as Organic Carbon (%)	<0.50	0.50-0.75	>0.75
2.	KMnO$_4$ Oxidizable N (kg/ha)	<280	280-560	>560
3.	Available Phosphorus Olsen P (kg/ha)	<10	10-25	>25
4.	Available Potash (K)in NH$_4$OAC (kg/ha)	<120	120-280	>280
5.	Available Sulphur - S (kg/ha)	<20	20-30	>30

In the second year soil parameter study under Polyhouse conditions (Table 2) Electrical Conductivity and pH ranged from 0.23 to 0.39 dSm^{-1} and 6.65 to 7.27 respectively which shows normal soil. Out of six, four soil samples were found to have low organic carbon rating while available nitrogen was found to have low fertility rating in all soil samples. However, available P was recorded under very high fertility rating and available K is higher in two samples (sample no. 3 & 5) and another four samples is under medium fertility rating of potassium according to the Soil Test Rating Limit as given in Table 3. They are advised to use only balance fertilizers or nutrients under Polyhouses.

CONCLUSION

This study has demonstrated the importance of soil properties as a regulating factor on nematodes. Thus, research on soil management should investigate the adequate source and quality of organic material to improve soil quality and suppress the growth of parasitic nematodes. However, long/medium term strategies by combining low input components alone or together with other management practices should be main aim for successful cultivation of crops even under Polyhouse conditions to bring down population level below threshold level. The best way for management of plant parasitic nematodes can be achieved by the integration of different farming practices. The various management strategies i.e., Physical, Chemical, Cultural, Biological, Regulatory and IPM are undertaken to minimize crop losses caused by phytonematodes. The major approach to INM involves simultaneous application of two or more strategies like Fungal Bioagents, judicious use of nematicides, neem cake can help in reducing phytonematode population even under Polyhouse conditions. It is one of the most feasible and reliable approach for the control of plant parasitic nematodes in different agricultural crops

for increasing crop productivity. Therefore, regular monitoring is the most important principles to detect any kind of malady developing by examining both soil/plant in polyhouses. Many biological control agents against nematodes are available for managing nematode population. Hence to maintain Greenhouse clean, paths should be free of soil, organic matter, weeds, algae, benches should be disinfected. Unhealthy plants and plant parts from the greenhouse have to be removed, sanitation, proper fertilization, organic supplements, monitoring and other attributes should be taken care. This study has demonstrated the importance of soil properties as regulating factor on nematodes. Thus, research on soil management helps to improve soil quality and suppress the growth of parasitic nematodes under Polyhouse conditions.

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ECONOMICS OF MAIZE PRODUCTION – A CASE STUDY

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ABSTRACT

The present study was undertaken (i). To study the existing farm resource structure and cost of cultivation of Maize crop. And(ii). To study the input-output relationship as well as various measures of farm profits in Maize crop on different size group of farms. The multi-stage stratified random sampling design was adopted for selecting the respondents. The required information collected from 60 Maize grower located in five villages in Badalapur blocks of Jaunpur district for the agricultural year 1917-18. The study revealed that the average total cost of cultivation of Maize was estimated at Rs.437531.01 per ha. Of which Rs.319114.41 was variable cost. Cost 'C' was found in decreasing order with increase with the size of farms. The overall average of input-output ratio on the basis of various costs varies from 1:1.24. There is a big opportunity to increase the income and employment if to identify the thrust areas of research and development programmesand priorities the same for effective achievement of the goal at the faster rates.

INTRODUCTION

Maize occupies a pride place among the coarse cereal crops in India. It commonly called "Queen of Cereals". It was first adopted and cultivated by the Latin American countries and was first introduced in India by the Portuguese during the 17th century. In India, it is cultivated throughout the year in most of its states for various purposes that include grain, feed, fodder, green cobs, sweet corn, baby corn, popcorn, starch, etc. The importance of Maize due to its wide diversity of use. It is grown in all the three seasons – (Summer-Zaid), (Winter-Rabi) and (Rainy- Kharif). The cultivation of Maize in Zaid is done for human consumption (Bhutta) and fodder in Uttar Pradesh. Maize is 3rd most important crop after rice and wheat in India. It current scenario,

the world production of Maize 370.96mm tones. In India was a production 42.3mm tones, Uttar Pradesh rank is seven. Uttar Pradesh accounts for 12.11 per cent of the total area and 8.14 per cent of the total production of Maize in the country. Jaunpur district is also an important Maize producing district of U.P. The area under Maize in the district during 2017-18 was reported to 43.06 tones ha with total production of 66.65 tones while productivity was 15.47qtl/ha. It is evident that the production of Maize in Jaunpur district is for below the productivity of State. It seems that there is scope of increasing productivity in this district for strengthening. The study was looked in to obtain an estimate of the increased income for farmers and increasing the crops yield through proper application of inputs at

recommended level and better management practices of the Maize crop. Seeing above facts in due consideration the study entitled "Economics Of Maize production" in Jaunpur district of Uttar Pradesh was undertaken with specific objectives to study the existing farm resource and to work out the cost incurred in cultivation of maize crops and also study the input-output relationship as well as various measures of farm profits on size groups of farms.

MATERIALS AND METHODS

A three stratified random sampling technique was used to select block, village and farmers. Badalapur block of Jaunpur district was selected purposively. A list of all the villages of this block was prepared along with their area and production under Maize and five villages were selected randomly. The study was based on 60 sample farms (i.e.-28 marginal, 19 small and 13 medium) from five villages under Badalapur block of Jaunpur district. The primary data were collected by survey method through personal interview on well-structured and pre-tested schedule while secondary data were collected from village records, block-headquarters, district statistical office, revenue department'sreports, journals, etc. The period of enquiry pertained to the agricultural year 2017-18. The over-all average was work out with the help of weighted mean for interpretation of data with the help of following formula –

$$WA = WX$$
$$X$$

Where,

W = weight of variable.

X = number of variable.

And also structured cropping intensity of Maize growers.

Total cropped area

Cropping intensity (C.I.) = X 100

Net Sown Area

RESULTS AND DISCUSSIONS-

Farm Resource structure and cropping intensity-

This part of result and discussions deals with the study based on a sample of 60 Maize growers which are stratified in to three size groups, a namely marginal (below 1 ha) small (1-2ha) and large (above 2 ha) with respect to their holding size. It is clear from the table – 1 that out of net cultivated area of sample farms 19.75 , 30.61 and 49.62 percent area belong to Marginal , Small and Large farms respectively. The average size of holding was observed 1.687 hectare. Table No- 2 indicates the maximum cropping intensity was observed to be 281.69 percent in case of Marginal farms, followed by small and large farms 276.07 and 259.25 respectively with an overall average of 272.25 percent.

Structure of Cost and Income-

The different cost concepts like as cost A_1, B_1 and C_1 were considered for the analysis of data , similarly the various income measure such as Gross income , Net income , farm business income , Family labour income and farm investment income are calculated for the sample farm. The cost of production of Maize Rs/quintal and input-output relationship have also been worked out on the basis of different costs.

Cost of Cultivation of Maize crop –

The presented Table – 3 indicate that on an average per hectare cost of cultivation of Maize was Rs 437531.04. The cost of cultivation was observed higher on Marginal farms (Rs 398860.2 and Rs 341704.59) respectively. The total cost of Marginal farm was maximum due to heavy expenditure on the use of harvesting manure and fertilizers 17.062 percent and 13.55 percent respectively. The further distribution of the costs of overall average farm, show the maximum expenditure on harvesting i.e. – 15.66 percent followed by human labour 13.29 percent , manure and fertilizers 12.83 percent ,

tractor charges 11.49 percent and intercultural 10.34 per cent respectively.

Measures of Cost and return of Maize crop-

Per hectare cost of input factor on the basis of cost concept given in Table No- 4. Show that the overall average per hectare, cost 'A', 'B', and 'C' were estimated Rs 319114.41, 419114.34 and Rs 437531.01 respectively. The overall average of total cost of cultivation was observed Rs 481284.05. The cost of cultivation has the negative relationship with the farm size as it increases with decrease in the size of farm. As far as the income measures are concerned it is observed from the said table that the gross income per hectare was maximum to Rs 826500on marginal followed by small and large farm i.e.- Rs 527250.00 and Rs 456000 respectively, whereas the average gross income on overall farm came to Rs 603250.00. The display in the Table No-5 revealed that the cost of production per quintal on the basis of total cost was highest Rs 1185.80/qtl on small farms followed by large and marginal to Rs 1174.68/qtl and Rs 1084.88/qtl respectively. The overall average of the input-output ratio on the basis of various costs varies farm 1:1.24.

Table - 1 : Average holding of sample farms under different size groups:

S.No.	Size of farms	No. of Farms	Net cultivated land (ha)	Average size of holding (ha.)
1.	Marginal (Below- 1 ha)	28	20.00 (19.75)	0.714
2.	Small (1-2 hac.)	19	31.00 (30.61)	1.631
3.	Large (2& above ha.)	13	50.25 (49.62)	3.865
	All Farms	60	101.25 (60)	1.687

Table - 2 : Cropping Intensity of different size group of farms :

S.No.	Size Of Farms	Cultivated Area (hac.)	Gross cropped area (ha)	Cropping Intensity (in %)
1.	Marginal	0.71	2.00	281.69
2.	Small	1.63	4.50	276.07
3.	Large	3.86	10.00	259.00
	All Farms	6.2	16.50	272.25

Problem faced by farmers in study area-

The major problem observed by farmers in the study area was problem of wild animal, followed by technical, marketing and financial problem presented Table No-6 indicates that the wild cattle problem was faced by the Maize growers of the study area was raised by 36.66 percent, which was the most common problem. The technical problem was observed that 28.33 percent cultivators suffering from the problem like quality of seed, seed rate, time of showing, balance dose of fertilizers and method of No. of intercultural and application of herbicide etc. The marketing problem is raised serious by growers and 21.66 percent of growers suffering the problem of forced sell, storage problem and complication at govt. purchase centers. And last problem was observed by growers is financing problem is 13.33 percent. Some general problem faced the problem like quality of seed, method of sowing, method of fertilizers application, plant protection measures, intercultural etc. due to lack of knowledge. Farmers faced main problem of higher costs of cultivation because they do not get input at reasonable rate, this enhances the cost of input.

Suggestions-

On the basis of constraints faced by the farmers in the study area it is suggested that government should must come forward along with

## Table - 3 : Per Hectare Cost of cultivation on different size group of sample farms :

S.no.	Particular	Size Of Farmers						Average	
		Marginal Farmers		Small Farmers		Large Farmers			
		Value(Rs.) %	%	Value(Rs.)	%	Value(Rs.)		Value(Rs.)	%
1.	Family Labour	34000	5.943	13750	3.447	7500	2.19	18416.66	4.209
2.	Hired Labour	10000	1.748	46500	11.658	62750	18.366	39750	9.085
	Total Human Labour	44000	7.691	60250	15.105	70250	20.55	58166.687	13.294
3.	Tractor Charges	66400	11.607	41000	10.279	43400	12.70	50266.667	11.488
4.	Seed	40080	7.006	27520	6.899	18920	5.53	28840	6.591
5.	Manures And Fertilisers	77490	13.456	48600	12.18442310		12.38	56133.33	12.829
6.	Plant Protection Measures	28400	4.964	26200	6.568	18800	5.50	24466.667	5.591
7.	Irrigation	- -	-	-	-	-	-	-	-
8.	Inter Culture	69600	12.167	34600	8.674	31600	9.24	45266.667	1.0345
9.	Harvesting	97600	17.062	60800	15.243	47200	13.81	68533.33	15.663
10.	Interest on Working Capital	8458.24	1.604	4890.2	1.226	4224.6	1.23	5857.68	1.338
11.	Rental Value of Land	140000	24.474	95000	23.87	65000	19.02	100000	22.855
	TOTAL COST	572028.24	100	398860.2	100	341704.59	100	437531.01	100

Table - 4 : Measures Of Cost and returns of Maize Crop

Particular	Marginal	Small	Large	Over all Average
Cost – A	398028.24	290110.2	269204.8	319114.41
Cost – B	538028.24	385110.2	334204.6	4191134.34
Cost – C	572028.24	398860.2	341704.6	437531.01
10% managerial charge on cost- c	57202.82	39886.02	34170.46	215361.57
Total cost of Cultivation	629231.06	438746.04	375875.06	481284.05
Yield (qt.hac)	580 qt/ha	370 qt/ha	320 qt/ha	393.66 qt/ha
Gross Income	826500	527250	456000	603250
Net Income	197268.94	88503.96	80124.94	121965.94
Cost Of Production (Rs./Qt.)	1084.88	1185.80	1174.60	1148.42
Family Labour Charge	288471.76	142139.8	121795.4	184135.65
Farm Business Income	428471.76	237139.8	186795.4	284135.65
Input- Output Ratio	1:1.31	1:1.20	1:1.21	1:1.24

Table - 5 : Major constraints found in the study area on different size group of farmers.

Sl.No.	Particulars	Marginal	Small	Large	Total	Rank
1	Wild Cattle problem	10 (37.03)	7 (36.82)	5 (35.71)	22 (36.66)	I
2	Technical Problem	7 (25.92)	7 (36.82)	3 (21.42)	17 (28.33)	II
3	Marketing Problem	8 (29.62)	3 (15.78)	2 (14.28)	13 (21.66)	III
4	Financial Problem	2 (7.40)	2 ()10.52	4 (28.57)	8 (13.33)	IV
	Total sample farm	27 (100)	19 (100)	27 (100)	27 (100)	
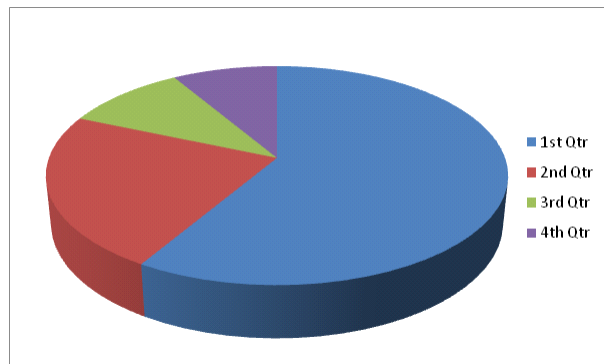
strong policy measures to check the problem of wild animal faced by the farms. It is also suggested that extension worker should come forward along with gov't of Agricultural department to solve the technical problem. State gov't should take proper action in time so that farmer can sell out their marketable surplus easily financial problem can be solved by creating easy for the farmer for getting K.C.C. (Kisan Credit Card) and other financial assistance from hand developments bank and office financial institutions.

CONCLUSIONS

It is concluded that marginal farmer earned more per rupees than small and large farm, mainly because of lower cost per unit of output. Loss the yield and income analysis show not much different in economics of Maize production at varying size of farm. The higher input-output ratio reflects that Maize is a profitable crop. The result of the study indicates that the average input-output ratio in Maize production varied from 1:1.20 small farm to 1:1.31 marginal farm on cost C_3 basis. The return per rupee of investment was higher in the Marginal size group of farms. It is suggested that for arguementing Maize production and modernizing the processing industry, cheaper credit agencies to the producers, processors and traders would help in increasing the productivity. There is need to increase use of hybrid seed in increased area and suggest the farmer to use improved fertilizers application method and modern production technology to the fullest extent possible

for increasing the total factor productivity.

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DNA BARCODE STUDIES ON THE INVASIVE LOCUST SCHISTOCERCA GREGARIA (FORSSKÅL, 1775) (ACRIDIDAE: ORTHOPTERA) FROM MAHARASHTRA, INDIA

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ABSTRACT

A massive one tenth of the world's livelihood is affected by Desert locust infestation which has been occurring since time immemorial. During the 2020 locust swarm Rajasthan, Gujarat, Delhi, Uttar Pradesh, Madhya Pradesh, and parts of Maharashtra along with other regions of India were severely affected warranting the need for better understanding of the dessert locust ecology and systematics. Dearth of genetic data for the Desert locust from India, where DNA barcoding is still infancy prompted the attempt of present study. The study reports first voucher-based DNA barcodes from specimen collected amidst the locust swarm in June 2020 in Maharashtra, India discussions are made on the necessity of Integrative taxonomic approach for identification of *Schistocerca.*

INTRODUCTION

Locusts are among the most devastating pests of human agriculture (Lockwood & Sardo, 2021). Their name is derived from the Latin *locus ustus,* meaning "burnt place" to describe the condition of the land after a swarm has passed. No pest problem spans such immense areas, with 16 million km^2 prone to outbreaks of the desert locust, *Schistocerca gregaria*, alone (Lockwood, 2016).

The desert locust has also been described as an international challenge. The 2020 locust swarm originated in Africa and entered in Rajasthan and Gujarat from Pakistan where it has migrated from Iran the previous year. The Desert Locust Bulletin of FAO (No.501, 3 July 2020) gives details about locust swarm origin and spread across continents). These pests then started to spread to western states, entering Vidarbha region in eastern Maharashtra, Delhi and Uttar Pradesh and Even Madhya Pradesh helped by strong winds. Swarms can migrate hundreds of Kilometers in a day and in vade areas spread over millions of Square Kilometers, causing major economic, social and environmental impacts internationally. It is estimated that one tenth of

world's populations livelihood are affected by desert locusts (FAO, 2016). Damage caused and socioeconomic consequences of locust and grasshopper outbreaks have led to an increasing paradigm shift from crop protection to preventive management (Zhang *et al*., 2019). Low populations of desert locust are usually found at any given time across the huge area of 16 million sq Km ranging from West Africa to Southwest Asia (Klein *et al*., 2021). Control efforts cost millions of dollars (Belanyh, 2005) and enormous quantities of chemical insecticides used can have serious side effects on the environment (Zhang *et al*., 2019). To be realistic, we cannot deny the likelihood of new upsurges and even new plagues in the decades to come. History has shown that the locust swarm

Table - 1 : Information on Locust invasion in ancient times.

Sl. No.	Occurrence	Reference
1	Ancient Egyptian tombs 2470 to 2220 BC	Pener *et al.,* 2014
2	Also mentioned in Mahabharata	Pener et al., 2014
3	Devastating plague in Egypt mentioned in Book of Exodus in Bible	*Book of Exodus*. pp. 10: 13–15
4	Plagues of locust also given in Quran	Showler, 2008
5	Chinese had anti-locust officers in 9th century BC	McNeill, 2012
6	There is mention of locust in New Testament and Book of Revelation	"Bible Gateway passage: Revelation 9:7 - King James Version". *Bible Gateway*
7	Aristotle also studied locusts and recorded a serious plague in Capua in 203 BC	McNeill, 2012

problem is very old and is well documented (Table 1).

The ability to change phase between solitarious and gregarious forms in response to population density is a key feature of locusts and is central to their occasional yet catastrophic impact on humans (Simpson *et al*., 1999). The transition between locust phases is thus reversible and occurs gradually through the expression of intermediate phenotypic states (Cullen *et al*., 2017; Pener and Simpson, 2009; Symmons and Cressman, 2001 and Verlinden *et al*., 2009). Literature shows that first draft of genome assembly of desert locust *Schistocerca gregaria* has been done. Sequencing and assembling the desert locust genome has been both challenging and ground-breaking due to the enormous size of the genome and its extremely large proportion of repetitive elements. The desert locust genome is the largest insect genome sequenced and assembled to date (Verlinden *et al*., 2020).

Peng *et al*. (2020) has reviewed locust outbreaks. According to FAO, 2020 outbreak was the worst in last 70 years possibly triggered by Climate change, hurricanes and heavy rains. Between 1912 to 1989, there have been large desert locust outbreaks, and all of them were closely related to dry and warm climate at that time (Meynard *et al*., 2017 Piou *et al*., 2013). If we look back at last 150 years of locust outbreaks, then America has seen 2, Australia also 2, Africa 3, Afghanistan 1, China has seen maximum number 7, Israel, Kazakhstan, Russia and Turkmenistan have seen one each (Peng *et al*., 2020).

The challenge consists in understanding the problems involved and envisaging approaches and solutions able to check situations in time before explosions occur (Skaf *et al*., 1990). Therefore, a taxonomic tool for locusts based on integrated taxonomic approach will be useful in their management. In case of locusts, there aren't any studies available using integrative taxonomy based on morphological and DNA barcoding approach.

MORPHO-TAXONOMY IN INSECTS

Morphometric analyses have been a useful technique in detecting morphological differences among organisms to distinguish closely related species. However, morphological tools present some limitations, mainly due to high homoplasy in most morphological characters and the existence of cryptic species groups across the insect groups. These limitations have promoted the use of molecular tool for quick and reliable identification of diverse taxa, like DNA barcodes. DNA Barcoding, which is a system that employs sequence diversity in short, standardized gene regions aids in identification of species (Ratnasingham and Herbert, 2007). This standardized method for identifications of species focuses sequencing efforts on one target gene, cytochrome c oxidase subunit I (COI) (Herbert *et al*., 2003 ab).

INTEGRATIVE TAXONOMY

Integrative taxonomy consists of integrating different data types for species delineation, and it is becoming widely accepted in modern taxonomy (Riedel *et al*., 2013; Blumel *et al*., 2014; Miraldo *et al*., 2014). As part of integrative taxonomy, molecular techniques are widely used, including DNA barcoding (Park *et al*., 2011; Astrin *et al*., 2012 and Alex Smith *et al*., 2013) in addition to the use of other mitochondrial and nuclear markers (Barco *et al*., 2013; Allegrucci *et al*., 2014; Yang *et al*., 2014; Gutierrez-Gutierrez *et al*., 2013) .

DNA barcodes offer high resolution than phenotypic data and their identity can be tested by building a phylogeny. Although mt COI is not suitable gene to be used for phylogenetic analysis, it is widely accepted among insect groups for species identification and documentation (Ratnasingham and Herbert, 2007). DNA barcodes cannot provide precise species identity without an authentic DNA barcode database (Hajibabai *et al*., 2007), which limits its application in further analysis due to inaccurate or misleading identity. This warrants generation of authentic baseline reference data linked to taxonomically identified specimens. The present study integrates data from morphology, morphometric, geographical distribution and DNA barcoding for *Schistocerca gregaria*, and forms the first DNA barcode report for the genus and species from India.

MATERIALS AND METHODS

Field Survey, Collection, and Identification

Field survey and sampling were done during June 2020. During a locust swarm in Maharashtra, in 2020 after a gap of several years (since 2013) samples of locusts were collected by net and hand picking from different localities in Nagpur district in Maharashtra, India and preserved dry as well as in 70% alcohol as shown in Table 1, 2 and 3. They were identified using standard taxonomic key for locust available on http://schistocerca.org

a) Insect sampling

DNA BARCODING AND PHYLOGENETIC STUDIES

Thoracic muscle tissue preserved in molecular grade alcohol was used to extract genomic DNA (gDNA) as per Qiagen kit. DNA

Table - 2 : Details of the geographic location of locust sample collection sites

Sl. No	Collection Locality	Latitude (N)	Longitude (E)
1	Orange orchards near Susundri village, Kalmeshwar, Nagpur	21.276	78.816
2	Kohali, Kalmeshwar, Nagpur	21.267	78.809
3	Sonoli, Kalmeshwar, Nagpur	21.281	78.839

quantitation was performed by HS dsDNA assay kit on Qubit 2.0 fluorometer. Mitochondrial COI (mt COI) gene was amplified using LCO1490 and HCO2198 (Folmer *et al*., 1994). Thermal cycling profile as per Hebert *et al*. (2003) with modifications includes, first cycle of denaturation at 95°C for 2mins, followed by 35 cycles of initial denaturation at 95°C for 0.5 mins, annealing at 48-51°C for 45secs, and extension at 72°C for one min; and final extension at 72°C for 5 mins. Amplified PCR product was confirmed by Gel Electrophoresis stained by SYBR safe DNA gel stain (Invitrogen), visualized under UV by Gel Documentation system. Column purification of amplified PCR products was carried out using Invitrogen's Pure Link PCR Purification Kit. Purified PCR product was sequenced bidirectionally by Sanger's method on ABI 377 (Applied Biosciences) sequencer.

Obtained sequences, both the forward and reverse were verified manually for corrections. NCBI Basic Local Alignment Search Tool (BLAST) (https://blast.ncbi.nlm.nih.gov/Blast.cgi) was used to confirm the sequence identity. Additionally, 581 *Schistocerca* sequences available in NCBI database for mt COI gene were downloaded for phylogenetic analysis with our generated sequences (Table 1). Sequence alignment, manual cleaning of the sequences, and stop codons verification was performed in MEGA X (Kumar *et al.* 2018). After confirming the monophyly of our generated sequences with *S. gregaria* in preliminary phylogenetic analysis; final Maximum likelihood (ML) tree was constructed using all *S. gregaria* sequences and one representative sequence from all species of *Schistocerca* in IQ-TREE multicore version 1.6.12 (Trifinopoulos *et al.,* 2016) web server for 1000 ultrafast bootstraps under GTR+F+I+G4 substitution model which was auto selected according to BIC (Bayesian Information

Criterion) with default parameters. Final consensus tree was visualised in Fig. Tree v 1.4 to treating members of genus *Nomadacris, Valanga and Acanthacris* as outgroups (Song *et al*., 2013).

RESULTS AND DISCUSSION

Morphologically Desert locust, genus *Schistocerca* is identified by Mesosternum with the length of lateral lobes longer than their width Prosternal process always present. Male subgenital plate always bilobed. Usually moderate to large size. Entirely in New World except *S. gregaria* which is found in the Old World. And, *Schistocerca gregaria* (Forsskål, 1775) can be identified based on the following set of the taxonomic characters, median carina of pronotum with deep sulci and hind tibiae brownish. Geographical distributed only in the Old World.

Insects show morphometric variations associated with the environment which may be result of either phenotypical responses or genetic inheritance, or both. Begon *et al*. (2006) reported that the individuals that composed a species population are not identical and may vary, sometimes very slightly, in size, development rate and/or in response to temperature. Studies point out that the variation in body size is a property of natural populations and has important ramifications for the understanding of the dynamics and stability of ecological systems (Filin and Ovadia, 2007). In the present study, morphometric measurements of male (n=10) and female individuals (n=10) were taken as shown in Table 4.

Morphological details:

PHYLOGENETIC ANALYSIS

For the phylogenetic analysis based on the single mt COI gene 83 sequences of *Schistocerca* 33 lineages could be recovered (Fig. 3). Interestingly the sequences labelled *Schistocerca gregaria* were not monophyletic (Fig. 3), this could be due to mislabeling of few sequences in the GenBank. On

Table 5: Morphometric details of Male (n=10) specimens
of *Schistocerca gregaria* Forskåls (values are in mm)

Register number	Head	Thorax	Abdomen	Forewing	Hind wing	Femur	Tibia	Tarsus
Ent 5/1795	8	15	37	63	57	25	23	6
Ent 5/1796	7	15	35	62	56	25	24	6
Ent 5/1797	8	14	36	56	51	25	24	7
Ent 5/1798	8	14	37	62	55	25	23	6
Ent 5/1799	7	14	34	59	52	24	21	7
Ent 5/1800	8	15	36	62	55	25	23	6
Ent 5/1801	7	14	36	61	57	25	24	6
Ent 5/1802	8	14	37	59	53	25	24	7
Ent 5/1803	8	14	36	63	56	24	23	7
Ent 5/1804	8	15	37	61	54	25	23	7
Mean(mm) ± SD	7.7±0.48	14.4±0.51	36.1±0.99	60.8±2.2	54.6±2.0	24.8±0.42	23.2±0.91	6.5±0.52

Table 5: Morphometric details of Female (n=10) specimens of Schistocerca
***gregaria* Forskål (values are in mm)**

Register number	Head	Thorax	Abdomen	Forewing	Hind wing	Femur	Tibia	Tarsus
Ent 5/1805	8	14	33	55	52	26	24	6
Ent 5/1806	7	12	32	54	49	25	22	6
Ent 5/1807	7	13	34	57	52	25	22	7
Ent 5/1808	8	12	33	54	51	25	22	6
Ent 5/1809	7	12	33	55	50	25	22	7
Ent 5/1810	8	13	35	58	52	25	22	7
Ent 5/1811	8	14	33	57	52	25	22	7
Ent 5/1812	8	13	32	54	49	25	22	6
Ent 5/1813	8	13	33	58	52	25	22	7
Ent 5/1814	7	12	34	57	52	25	22	6
Mean (mm)± SD	7.6 ± 0.51	12.8 ± 0.78	33.2 ± 0.91	55.9 ± 1.66	51.1 ± 1.28	25.1 ± 0.31	22.2 ± 0.63	6.5 ± 0.52

the contrary all the sequences *Schistocerca gregaria* from Egypt and Ethiopia were forming a monophyletic clade with the other sequences of other country confirming the identity as the type locality for the species is Egypt.

In the tree *Schistocerca gregaria* was exhibiting sister relationship with the sub-species *Schistocerca gregaria flaviventris* from South Africa. Genetic distance among the members of the clade comprising *Schistocerca gregaria* from the type locality USA, Ethiopia, Palearctic and oriental biogeographic regions varied from 0.5% to 2.9%.

Appendix - I : Sequences details used for Maximum-Likelihood analysis for *Schistocerca* genus.

Sr. no	Gen Bank Acc. No.	Species name	Locality	Publication status as per NCBI
1	D460a	*S. gregaria*	India: Maharashtra, Nagpur	This study
2	D/460b	*S. gregaria*	India: Maharashtra, Nagpur	This study
3	D/463a	*S. gregaria*	India: Maharashtra, Nagpur	This study
4	D/463b	*S. gregaria*	India: Maharashtra, Nagpur	This study
5	KU251463.1	*S. gregaria gregaria*	Mauritania: Traza	Chapuis et al. 2016
6	KY980902.1	*S. gregaria*	Egypt	Song et al. 2017
7	KU251467.1	*S. gregaria gregaria*	Morocco: Bas Draa	Chapuis et al. 2016
8	KU251466.1	*S. gregaria gregaria*	Sudan	Chapuis et al. 2016
9	KU251468.1	*S. gregaria gregaria*	Chad: Borkou	Chapuis et al. 2016
10	EU203997.1	*S. gregaria*	Morocco	Unpublished
11	KM384835.1	*S. gregaria*	Spain	Unpublished
12	JX244362.1	*S. gregaria*	Spain	Unpublished
13	KU251462.1	*S. gregaria gregaria*	Algeria: Tikouet waddis	Chapuis et al. 2016
14	AB497584.1	*S. gregaria*	Ethiopia	Tokuda et al. 2010
15	KU251465.1	*S. gregaria gregaria*	Pakistan	Chapuis et al. 2016
16	KU251464.1	*S. gregaria gregaria*	Niger: Tamesna	Chapuis et al. 2016
17	AF260532.1	*S. gregaria*	Simon Fraser University	Chapco et al. 2001
18	KU251474.1	*S. gregaria flaviventris*	South Africa: Tankwa Karoo National Park	Chapuis et al. 2016
19	KU251473.1	*S. gregaria flaviventris*	South Africa: Tankwa Karoo National Park	Chapuis et al. 2016
20	KU251472.1	*S. gregaria flaviventris*	South Africa: Richtersveld National Park	Chapuis et al. 2016
21	KU251470.1	*S. gregaria flaviventris*	South Africa: Namaqua National Park	Chapuis et al. 2016
22	KU251471.1	*S. gregaria flaviventris*	South Africa: Richtersveld National Park	Chapuis et al. 2016
23	KU251469.1	*S. gregaria flaviventris*	South Africa: Rietfontein	Chapuis et al. 2016
24	GU115929.1	*S. impleta*	Mexico: Rancho El Gualul Motorway Estacion, Manuel a Ebano S.LP. Km 11	Song et al. 2013
25	GU116256.1	*S. pallens*	Mexico: Rancho El Gualul Motorway Estacion, Manuel a Ebano S.LP. Km 11	Song et al. 2013
26	GU115865.1	*S. gregaria*	USA	Song et al. 2013
27	KY980920.1	*S. cohni*	Mexico: Oaxaca, Hwy#190 Oaxaca Tehuantepec	Song et al. 2017

Sr.	Gen Bank Acc. No.	Species name	Locality	Publication status as per NCBI
28	GU115864.1	*S. melanocera*	Ecuador: Galapagos Islands, Isla Floreana, Finca Cruz ft. of Cerro Communista	Song et al. 2013
29	KY980895.1	*S. obscura*	USA: FL, Suwannee Co. Suwannee River State Park	Song et al. 2017
30	GU116084.1	*S. alutacea*	USA: FL, Walton Co. DeFuniak Springs, off SR 90 W Oakwood Hills	Song et al. 2013
31	GU116110.1	*S. rubiginosa*	USA: FL, Walton Co. DeFuniak Springs, off SR 90 W Oakwood Hills	Song et al. 2013
32	GU115882.1	*S. ceratiola*	USA: FL, Putnam Co. Katherine Ordway Preserve	Song et al. 2013
33	KM244018.1	*S. lineata*	USA	Unpublished
34	KM243999.1	*S. shoshone*	USA	Unpublished
35	GU116014.1	*S. albolineata*	USA: AZ, Pima Co. Tucson Mts. off Gates Pass Rd	Song et al. 2013
36	GU116119.1	*S. damnifica*	USA: FL, Levy Co. Off SR 121	Song et al. 2013
37	KY980898.1	*S. centralis*	Costa Rica, Puntarenas Province, Pacifico Central, Jaco Beach	Song et al. 2017
38	GU116177.1	*S. americana*	USA: FL, Marion Co. Jct. CR 318 & CR 329	Song et al. 2013
39	KY980900.1	*S. serialis cubense*	USA: FL, Florida Keys	Song et al. 2017
40	GU115942.1	*S. gregaria*	USA	Song et al. 2013
41	GU116386.1	*S. gregaria*	USA	Song et al. 2013
42	GU116374.1	*S. gregaria*	USA	Song et al. 2013
43	GU116445.1	*S. socorro*	Mexico: Islas Revillagigedo, Isla Socorro	Song et al. 2013
44	GU115922.1	*S. piceifrons*	Mexico: Rancho El Gualul Motorway Estacion, Manuel a Ebano S.LP. Km 11	Song et al. 2013
45	GU116402.1	*S. gregaria*	USA	Song et al. 2013
46	GU116206.1	*S. nitens*	USA	Song et al. 2017
47	GU116398.1	*S. gregaria*	USA	Song et al. 2013
48	GU116385.1	*S. gregaria*	USA	Song et al. 2013
49	GU116378.1	*S. gregaria*	USA	Song et al. 2013
50	GU115962.1	*S. cancellata*	USA	Song et al. 2013
51	GU116390.1	*S. gregaria*	USA	Song et al. 2013
52	GU116380.1	*S. gregaria*	USA	Song et al. 2013
53	GU115940.1	*S. gregaria*	USA	Song et al. 2013
54	GU115939.1	*S. gregaria*	USA	Song et al. 2013

Sr.	Gen Bank Acc. No.	Species name	Locality	Publication status as per NCBI
55	GU115938.1	*S. gregaria*	USA	Song et al. 2013
56	GU116376.1	*S. gregaria*	USA	Song et al. 2013
57	GU116370.1	*S. gregaria*	USA	Song et al. 2013
58	GU116393.1	*S. gregaria*	USA	Song et al. 2013
59	GU116373.1	*S. gregaria*	USA	Song et al. 2013
60	GU115941.1	*S. gregaria*	USA	Song et al. 2013
61	GU116379.1	*S. gregaria*	USA	Song et al. 2013
62	GU116388.1	*S. gregaria*	USA	Song et al. 2013
63	GU116382.1	*S. gregaria*	USA	Song et al. 2013
64	GU116391.1	*S. gregaria*	USA	Song et al. 2013
65	GU116387.1	*S. gregaria*	USA	Song et al. 2013
66	GU116377.1	*S. gregaria*	USA	Song et al. 2013
67	GU116372.1	*S. gregaria*	USA	Song et al. 2013
68	GU116381.1	*S. gregaria*	USA	Song et al. 2013
69	GU116371.1	*S. gregaria*	USA	Song et al. 2013
70	KY980916.1	*S. flavofasciata*	USA	Song et al. 2017
71	GU116396.1	*S. gregaria*	USA	Song et al. 2013
72	GU116395.1	*S. gregaria*	USA	Song et al. 2013
73	GU116392.1	*S. gregaria*	USA	Song et al. 2013
74	GU116384.1	*S. gregaria*	USA	Song et al. 2013
75	GU116383.1	*S. gregaria*	USA	Song et al. 2013
76	GU116389.1	*S. gregaria*	USA	Song et al. 2013
77	GU116421.1	*S. quisqueya*	Dominican Republic: RD-060, Monte Rio	Song et al. 2013
78	GU116401.1	*S. gregaria*	USA	Song et al. 2013
79	GU116339.1	*S. literosa*	Ecuador: Galapagos Islands, Espanola	Song et al. 2013
80	GU116400.1	*S. gregaria*	USA	Song et al. 2013
81	GU116399.1	*S. gregaria*	USA	Song et al. 2013
82	GU116375.1	*S. gregaria*	USA	Song et al. 2013
83	GU116397.1	*S. gregaria*	USA	Song et al. 2013
84	JF838519.1	*Nomadacris succincta*	Pakistan	Unpublished
85	JF838518.1	*Nomadacris succincta*	Pakistan	Unpublished
86	GU115848.1	*Valanga* sp. HS-2010	PNG: Eastern Highlands Province Herowana Village Crater	Song et al. 2013

Sr.	Gen Bank Acc. No.	Species name	Locality	Publication status as per NCBI
87	KY980924.1	*Valanga* sp. HS-2017	PNG: Eastern Highlands Province, Herowana Village Crater Mountain Research Area	Song et al. 2017
88	KY980907.1	*Acanthacris ruficornis*	South Africa: Western Cape Prov. Theewaterskloof Dam	Song et al. 2017
89	GU115846.1	*Acanthacris ruficornis*	Namibia: Etosha NP	Song et al. 2013

The type locality of *S. gregaria* is Egypt, Le Caire while in the original description by Forskål (1775) the species is mentioned to be found in Saudi Arabia, Yemen, and Egypt. On the tree we could include 23 species of *Schistocerca* and multiple lineages named as *S. gregaria* (Fig 3). Barring the clade of *S. gregaria* from the type locality rest of the clades / sequences could be mislabeled or wrongly identified. The tree suggests the uncertainties in the identification of *S. gregaria* and requires taxonomic attention. Genetic data can aid in resolving in the taxonomy of *S. gregaria* in future and our study forms a baseline data from India which can be used to confirm correct *S. gregaria* identity and related studies.

The DNA barcode data generated for the swarm species like *S. gregaria* helps in tracking the swarms and swarming patterns for the effective management in future including the quarantine facilities.

CONFLICTS OF INTEREST :

The authors declare no conflict of interest.

Author contributions: All authors conceptualized the study. PSB, DV and SSK did the field survey and collected the specimen and ecological notes. DV performed morphometry and morphological studies. AS performed molecular wet lab. KPD and AS performed the Phylogenetic Analysis. KPD performed phylogenetic data interpretation. All authors contributed to manuscript writing, editing, and proof reading.

Figure 1: Desert Locust swarms near Susundri village, Kalmeshwar, Nagpur, Maharashtra, India

Figure 2: Locusts *Schistocerca gregaria* (Forsskål, 1775) near Susundri village, Kalmeshwar, Nagpur, Maharashtra, India
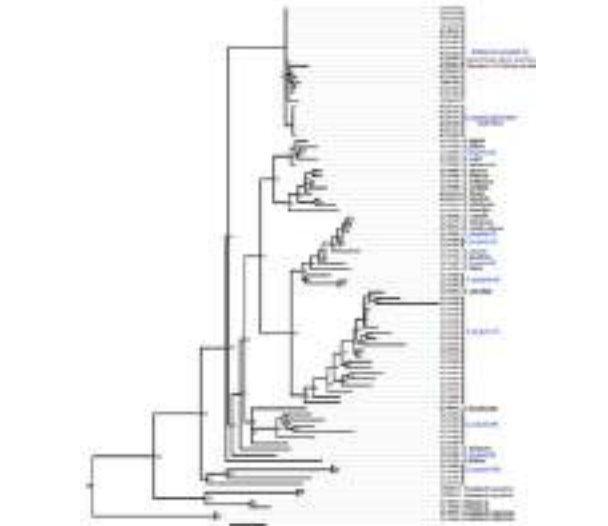
Figure 3: mtCOI Maximum likelihood phylogenetic tree for the members of *Schisto*
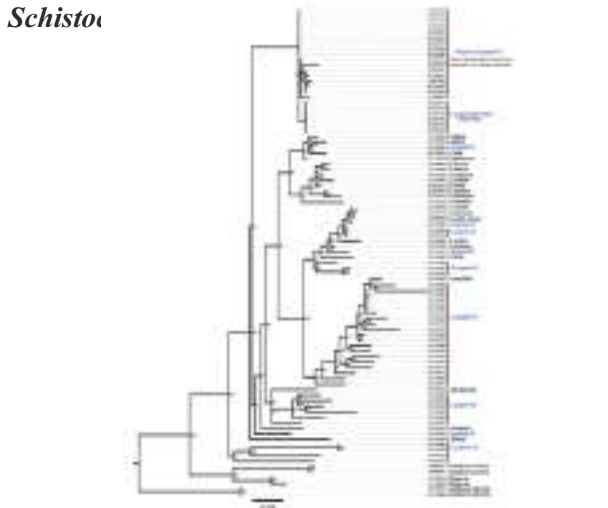
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CHALLENGES PLAGUING SUGARCANE GROWERS

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ABSTRACT

Entrepreneurship stands as a driving force behind economic development, epitomizing innovation, risk-taking and resourcefulness. This paper explores the role of entrepreneurship in the agricultural sector, particularly in sugarcane cultivation in the Kushinagar district of Uttar Pradesh, India. Through a comprehensive research methodology involving survey data from 120 sugarcane growers, the study identifies key constraints faced by farmers in adopting new technologies and practices. These constraints include a lack of credit facilities, scientific knowledge, field labor and proper market infrastructure, alongside challenges such as poor economic conditions and high input costs. Moreover, the study presents suggestions provided by farmers to overcome these constraints, emphasizing the importance of timely credit availability, government support for irrigation, training in new technologies and increased subsidies on fertilizers and pesticides. Drawing on insights from existing literature, the paper outlines future research directions, highlighting the need for further exploration of socio-economic factors influencing technology adoption and the impact of government interventions on sugarcane farming practices. This research contributes to understanding the dynamics of entrepreneurship in agriculture and offers valuable insights for policymakers, agricultural practitioners and researchers alike.

INTRODUCTION

Entrepreneurship stands as a cornerstone of economic development, embodying the spirit of innovation, risk-taking and resourcefulness. Rooted in the pursuit of creating and managing business ventures amidst uncertainties, entrepreneurship epitomizes the drive to generate profits and contribute to economic growth. At its core, entrepreneurship encompasses the ability and willingness to conceptualize, organize and operate businesses, leveraging resources such as land, labor, natural resources and capital to realize entrepreneurial visions. Dating back to the roots of economic history, the essence of entrepreneurship can be traced to early traders and merchants who engaged in exchange activities, laying the groundwork for modern-day commerce. The term "entrepreneurship" finds its etymological origin in the French word "*entreprendre*" meaning to undertake or do something. However, it was Joseph Schumpeter, the renowned Austrian economist, who crystallized the concept of entrepreneurship,

emphasizing its pivotal role in fostering economic dynamism through innovation and creative destruction.

In contemporary times, entrepreneurship has evolved beyond mere profit-making endeavors to encompass a broader spectrum of societal impact and value creation. While entrepreneurs traditionally ventured into sectors ranging from small businesses to scalable startups and large corporations, recent trends have seen a surge in social entrepreneurship, where ventures prioritize social or environmental objectives alongside financial returns. This expanding landscape underscores the transformative potential of entrepreneurship in addressing pressing societal challenges and driving inclusive growth. Recognizing the significance of entrepreneurship in driving economic prosperity, governments worldwide have instituted various initiatives to nurture entrepreneurial ecosystems and empower aspiring entrepreneurs. In India, for instance, the government has launched Entrepreneurship Development Programs (EDPs) and initiatives like Training of Rural Youth for Self-Employment (TRYSEM) to foster entrepreneurship, particularly in rural areas. Moreover, educational institutions have integrated entrepreneurship management and development courses into their curricula, equipping students with the requisite skills and knowledge to embark on entrepreneurial ventures.

The agricultural sector, a cornerstone of the Indian economy has witnessed a paradigm shift with the adoption of innovative technologies and practices by farmers. Sugarcane cultivation, in particular, plays a pivotal role in India's agricultural landscape, contributing significantly to GDP and employment generation. The evolution of entrepreneurship in agriculture underscores its potential to drive productivity enhancements and rural development, thereby bolstering the resilience of agrarian economies.

MATERIALS AND METHODS

The study was conducted in Kushinagar district of Uttar Pradesh which has 14 blocks Due to limited time. And resources, the variable-age, education, marital status, family type, family size, annual income, social participation, extension participation behaviour of farmers by asking direct question to each respondent. Thus make a total number of 12 villages were selected for the study. From each village twelve respondents were selected randomly. Thus, make a total number of 120 respondents were selected for the study.

Constraints in adoption of new technology never end. However, they can be minimized. The respondents were requested to express the constraints faced by them in sugarcane farming. Constraint refers as situation or circumstances which impede, restrict, or control the performance of an individual's activity. In the present study, it was measured by considering the all possible as well as common difficulties experienced by the sugarcane growers during the full use of scientific management practices of sugarcane farming. Then constraints were summed up and converted into mean percentage score. Later on, the constraints were presented in rank order.

RESULTS AND DISCUSSION
Constraints faced by sugarcane growers

Table-1: Constraints faced by sugarcane growers

S.N.	Constraints	MPS	Rank
1	Lack of credit facilities	85.00	IV
2	Lack of scientific knowledge	67.50	VI
3	Lack of field labor	57.50	VII
4	Poor economic condition	102	II
5	Lack of proper market in the area	111	I
6	High cost of plant protection measure	69	VI
7	High cost of improved seeds	96	III

It was revealed that from table no 4.3.1 that out of total 120 respondent of sugarcane growers, lack of knowledge about sugarcane cultivation With Rank VI, lack of credit facilities With Rank IV, lack of proper market in the area With Rank I, poor economic condition of sugarcane growers With Rank II, high cost of improve seeds With Rank III, high cost of plant protection measure With Rank VI, lack of field labor With Rank VII, Respectively. Jaiswal*et al.* (2012) and Patel *et al.* (2015)

Suggestions to overcome their constraints faced by sugarcane growers.

Suggestion refers to as an opinion about constraint, which can be used as a solution to overcome or to minimize. The constraints faced by them may sometimes be imaginary and sometimes due to lack of knowledge or coordination requires at different levels. Hence in this study, all the sugarcane farmers were requested to offer their valued suggestions for eliminating the constraints. The suggestions relatively indicated that associated with same aspect were clubbed and converted into mean percentage score and lastly rank was assigned. The data in this regard is presented in table.

Table - 2 : Suggestions to overcome their constraints faced by sugarcane growers.

S.N.	Suggestion	MPS	Rank
1	Credit should be availed in time	84	V
2	Government should provide irrigation facilities	87.50	III
3	Government should provide training new technology	74.16	VI
4	Government should provide insurance for sugarcane crop	67.50	VII
5	Government should provide proper market facilities	80.83	IV
6	Subsidy should be increase on plant protection fertilizer	112	I
7	Fertilizer and pesticides availed in minimum cost	108	II

It was revealed that from table no 4.4.1 that out of total 120 respondent of sugarcane growers, Lack of Subsidy should be increase on plant protection fertilizer With Rank I, Fertilizer and pesticides on plant protection fertilizer With Rank II, Government should provide irrigation facilities With Rank III, Government should provide proper market facilities With Rank IV, Credit should be availed in time With Rank V, Government should provide training new technology With Rank VI, Government should provide insurance for sugarcane crop With Rank VII, Respectively. Paudel*et al.* (2018) and Kumar *et al.* (2019)

Future Scope:

The findings of this study shed light on the multifaceted challenges faced by sugarcane growers in the Kushinagar district of Uttar Pradesh. However, this research opens avenues for further exploration and intervention to address these constraints effectively. Future studies could delve deeper into the specific socio-economic factors influencing the adoption of new technologies in sugarcane farming, considering variables such as age, education and income levels among farmers. Additionally, there is scope for conducting comparative studies across different regions to discern regional disparities in the challenges faced by sugarcane growers and identify region-specific solutions. Moreover, longitudinal studies tracking the impact of government initiatives, such as subsidies and training programs, on sugarcane cultivation practices and farmer livelihoods could provide valuable insights into policy effectiveness and areas for improvement.

CONCLUSION

In conclusion, the study underscores the significant challenges confronting sugarcane growers in the Kushinagar district, ranging from inadequate access to credit facilities and scientific knowledge to poor market infrastructure and high input costs. These constraints not only impede the adoption of modern farming practices but also undermine the socio-economic well-being of farmers. However, amidst these challenges lie opportunities for intervention and improvement. By addressing the identified constraints through

targeted policy interventions, such as enhancing access to credit, providing training in modern agricultural practices and strengthening market linkages, stakeholders can empower sugarcane growers to enhance productivity and profitability. Moreover, the findings underscore the imperative of holistic approaches that integrate technological, institutional and policy interventions to foster sustainable agricultural development and enhance the resilience of agrarian economies. By leveraging the transformative potential of entrepreneurship and innovation in agriculture, stakeholders can catalyze positive change and drive inclusive growth in the sugarcane sector and beyond.

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EXPLORING CONSUMER PERSPECTIVES ON COUNTERFEIT FAST MOVING CONSUMER GOODS (FMCG) FOOD PRODUCTS IN RURAL PRAYAGRAJ DISTRICT, UTTAR PRADESH: AN ANALYTICAL STUDY

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ABSTRACT

India has emerged as a hub for the production of counterfeit fast moving consumer goods (FMCG), particularly in the food and beverages sector, leading to significant violations of Intellectual Property Rights. This study, conducted in the Prayagraj district of Uttar Pradesh, aims to examine consumer perceptions and behaviors towards counterfeit FMCG food products. Data collection involved interviews with respondents using a structured questionnaire, supplemented by secondary data obtained from online sources such as reports, journals, and research papers. Statistical analyses including percentage analysis and the implementation of a five-point Likert scale were utilized for data interpretation. The research findings highlight that cold-drinks (28%) and biscuits and chips (26%) emerged as the most preferred counterfeit food products among respondents. A substantial proportion (50%) of respondents expressed agreement with the notion of purchasing counterfeit food and beverage products due to the high cost of genuine alternatives. Price (52%) and product quality (50%) emerged as the most influential factors driving the purchase of counterfeit FMCG food products. This study contributes to understanding consumer attitudes and motivations towards counterfeit goods in the rural areas of Prayagraj District, shedding light on pertinent issues surrounding intellectual property rights and consumer behavior in the FMCG sector.

INTRODUCTION

India is one of the highest expanding economies in the globe with the estimated average growth rate of 6-6.8 per cent (Economic survey, 2023-24). In India there are profitable markets for consumer products, therefore attracting a strong and unremitting flow of investments in scalable businesses with a well-built back-end supply chain.

The food industry of our country has emerged as a higher growth and highly profitable division because of its value addition potential, especially in the food processing industry. According to ASSOCHAM-Grant Thorton Research paper, Indian food processing sector has the potential to attract USD 33 billion of investment and create nine million jobs by financial year 2024. The

Government of India has been influential in the augmentation and the build out of the Indian food processing industry, accounts almost country's 32 per cent total food market. The Ministry of Food Processing Industries (MoFPI) is making the efforts to cheer the overall investments in the food sector of India under the continuous supervision of the Government of India. It has accepted proposals for foreign collaborations, joint ventures and industrial licenses 100 per cent export-cantered units (Business-Standard). Food processing sector also accounts for 32 per cent of Indian food market in food processing industry and 11.6 per cent share of employment in the domestic food industry. Further, it accounts for 2.2 per cent of total Foreign Direct Investment inflows in India. However, the disorganized food segment primarily dominates the food industry; the organized sector is likely to grow during the projected time of the financial year 2020-2024 (businesswire.com). The Indian food processing industry has been valued at INR 25,691.30 billion during the financial year 2018 and is likely to reach INR 53,436.52 billion during the financial year 2024 mounting at a Compound Annual Growth Rate of 12.09 per cent during the financial year 2020-2024 (businesswire.com). The India food processing market size reached INR 25,455 billion in 2022. As IMARC Group expects the market to reach INR 45,345 billion by 2028, exhibiting a growth rate (CAGR) of 9.5% during 2023-2028. The Indian food sector can be segmented into various sub-sectors such as, fruits and vegetables, fish processing, dairy handling, meat and poultry grains and spices processing. However, the industry is highly uneven and the existence of established competitors such as Mother Dairy Fruit & Vegetable Private Limited, Dabur India Limited, ITC Limited, and Shimla Hills Offerings Private Limited.

Counterfeiting in India

Indian markets have one of the greatest rates of rising consumption in the world. This makes it an alluring nation for item forgers who can represent a significant danger for organizations and buyers the same. India has become base for manufacturing counterfeit fast moving consumer goods (FMCG) food and Beverages Products account for maximum Intellectual Property Rights violations. Anti-counterfeiting and traceability solution vendors form a self-regulatory industry body. The Authentication Solution Providers Association (ASPA), reveal the first publication of its report "The State of Counterfeiting in India 2020", that portrays the patterns of forging occurrences inside the India for the year 2018 and 2019 (labelsandlabeling.com). As indicated by the report, forging episodes have risen consistently over the most recent couple of years and in 2019 these have expanded by 24 percent when contrasted with 2018. Internationally, forging presently remains at 3.3 percent of worldwide exchange and is affecting the social and economic improvement of nations. Indeed, even in the Covid-19 emergency, it has been seen that the lawbreakers are exploiting the high market interest for individual insurance and cleanliness items and giving phony and unsatisfactory items which are an immediate danger to our paramedical experts, security volunteers, and society. In India, the quantity of counterfeit episodes in India has increased by 24 percent between 2018-2019. The main ten areas with the most noteworthy number of counterfeit cases revealed incorporate money, FMCG, liquor, drug, reports, farming, framework, car, tobacco, way of life and attire. Among these money, liquor and FMCG keep on being the main three areas with the most elevated counterfeit occurrences over the most recent two years. Among these, the fast-moving consumer goods portion is commonly feeble as counterfeit events in the part extended by 63 percent during

2018-19. Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, West Bengal, Punjab, Jharkhand, Delhi, Gujarat, and Uttrakhand are among the top 10 states that require serious consideration in terms of strategy component design. UP is in first place, followed by Bihar and Rajasthan, and these three states account for almost 45 percent of all counterfeit events discovered in India in the last two years. Basic everyday things including cumin seeds, mustard cooking oil, ghee, and hair oil are just a few examples. Cleansers, infant care immunizations and medication are progressively detailed falsified by lawbreakers. A spike in cases being accounted for about phony hand sanitizers, veils, and personal protective equipment units has been seen during the COVID emergency. More than 150 counterfeit events were reported between February and April 2020, including counterfeit PPE packs, sanitizers, and veils. 'The trends call for sure fire activity,' said Authentication Solution Providers' Association (ASPA) president Nakul Pasricha. Consumer perception pegged the extent of counterfeiting at 25-30 per cent of the market, higher than the general industry expectations. Counterfeiting is most prevalent in FMCG, Apparel, and Agrochemical sectors (30 per cent), followed by the pharmaceutical, automotive, and consumer durables sectors (20-25 per cent). The survey also reveals that almost 89 per cent of consumers acknowledge the presence of fake products in the market and are often compelled to buy counterfeits for reasons such as sensitivity to price, demand-supply gap, desire to buy luxury brands, peer pressure, and social motivations (Report of Business world, 2024). Fake goods are costing India's economy about INR 1 trillion (1 lakh crore) on a regular basis, and current technological advancements are insufficient to combat this 21st-century malfeasance. There is a need for a constant focus on creating and maintaining confirmation eco-frameworks in the

country, and as an industry association, we are committed to do so. As a lot of attention is required at the company, government, and shopper levels, the collaboration and active investment of all parties is critical. The validation condition will support the government's "Make in India" initiative and its image on a global scale, where trust is becoming an increasingly important component. We must ensure that the "Make in India" products are genuine, safe, and secure until they are delivered to the final client around the world. Authentication Solution Providers' Association (ASPA)is working on innovative technology to aid law enforcement.

MATERIALS AND METHODS

✓ Locale of Study: -The area of the research was Prayagraj. Two blocks identified to conduct the study were Phoolpur and Soraon.

✓ Type of Study: The present study was based on descriptive type of research and quantitative techniques were used to carry out the research.

✓ Sampling Techniques: The present study adopted multistage random sampling technique to conduct the survey in Prayagraj.

✓ Sample Size: -For the purpose of the study, 100 consumers were randomly selected from rural areas of Phoolpurand Soraon blocks for the purpose of the study. Further two villages from each block are selected randomly named as Gagaur and Chilaura from phoolpur block and bhadalpur and Lakhanipur from Soraon block. Twenty-five respondents from each village were randomly chosen.

✓ Data collection: - The present study adopted both the primary as well as the secondary data collection techniques to conduct the present study. A pre-determined scale

developed by Martineau (1958) was used as a tool for data collection.

o   Primary Data: - It involves the firsthand information collected through questionnaire/schedule by interviewing the respondents.

o   Secondary Data: - The data which has already been collected, compiled and presented earlier by any agency was used for the purpose of investigation. The data was collected through websites, journals and magazines, etc.

✓   Analysis technique: After collecting the data, the results were analyzed by using percentage analysis using Microsoft excel. The Likert scale method is used to analyze the factors and the consumer preferences and do their scaling on the five-point Likert scale.

RESULTS AND DISCUSSION

Convenience sampling procedure was adopted for the selection of respondents. A total of 100 respondents were surveyed who gave valuable information regarding their perception level. The collected data was analyzed by employing tabular analysis (frequencies, percentages) to arrive at meaningful conclusions. The sequence of findings of the study is depicted in the form of tables and figures under the following headings

•   **Type of counterfeit food products preferred by the respondents most**

Table 1 represents the type of counterfeit food products preferred by the respondents. Out of 100 respondents the 18 respondents i.e. (18 per cent) said that they prefer juices, followed by 11 respondents i.e. (11 per cent) said that they prefer water, followed by 17 respondents i.e. (17 per cent) said that they prefer chocolates and confectionaries, followed by 26 respondents i.e. (26 per cent) said that they prefer biscuits and chips, followed by 28

respondents i.e. (28 per cent) said that they prefer cold drinks.

Table : 1 - Type of counterfeit food products preferred by the respondents most

Products	Frequency	Percentage
Juices	18	18
Water	11	11
Chocolates and confectionaries	17	17
Biscuits and chips	26	26
Cold drinks	28	28
Total	100	100

•   **Perception of respondents towards counterfeit fast moving consumer goods food products**

Table 2 represents the perception of respondents towards counterfeit fast moving consumer goods food products. Regarding (counterfeit food and beverages products are lookalike of original products) out of 100 respondents the 16 respondents i.e. (16 per cent) said that they are strongly disagree with the statement, followed by six respondents i.e. (6 per cent) said that they are disagree with the statement, followed by 8 respondents i.e. (8 per cent) said that they are neutral with the statement, followed by 38 respondents i.e. (38 per cent) said that they are agree with the statement, followed by 32 respondents i.e. (32 per cent) said that they are strongly agree with the statement. Regarding (Buying counterfeit food and beverages products just because the original ones are very expensive) out of 100 respondents the three respondents i.e. (3 per cent) said that they are strongly disagree with the statement, followed by 4 respondents found to be disagree with the statement (4 per cent) said that they are disagree with the statement, followed by 13 respondents i.e. (13 per cent) said that they are neutral with the statement, followed by 50 respondents i.e. (50 per cent) said that they are agree with the statement, followed by

30 respondents i.e. (30 per cent) said that they are strongly agree with the statement. Regarding (Buying counterfeit food and beverages products even if the original products are easily affordable) out of 100 respondents the 18 respondents i.e. (18 per cent) said that they are strongly disagree with the statement, followed by 21 respondents i.e. (21 per cent) said that they are disagree with the statement, followed by 20 respondents i.e. (20 per cent) said that they are neutral with the statement, followed by 22 respondents i.e. (22 per cent) said that they are agree with the statement, followed by 19 respondents i.e. (19 per cent) said that they are strongly agree with the statement. Regarding (Buying counterfeit food and beverages products demonstrates that the consumer is very rational) out of 100 respondents the 35 respondents i.e. (35 per cent) said that they are strongly disagree with the statement, followed by 10 respondents i.e. (10 per cent) said that they are disagree with the statement, followed by two respondents i.e. (2 per cent) said that they are neutral with the statement, followed by 22 respondents i.e. (22 per cent) said that they are agree with the statement, followed by 31 respondents i.e. (31 per cent) said that they are strongly agree with the statement.

Table - 2 : Perception of respondents towards counterfeit fast moving consumer goods food products

Factors	Frequency						Percentage				
	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)	Total	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
Counterfeit food and beverages products are lookalike of original products.	16	6	8	38	32	100	16	6	8	38	32
Buying more of counterfeit food and beverages products just because the original ones are very expensive	3	4	13	50	30	100	3	4	13	50	30
Buying counterfeit food and beverages products even if the original products are easily affordable	18	21	20	22	19	100	18	21	20	22	19
Buying counterfeit food and beverages products demonstrates that the consumer is very rational	35	10	2	22	31	100	35	10	2	22	31
Total	72	41	43	132	112		72	41	43	132	112

- **Factors responsible for buying counterfeit fast moving consumer goods food products**

Table 3 represents Factors responsible for buying counterfeit fast moving consumer goods food products. Regarding (Product design) out of 100 respondents the 38 respondents i.e. (38 per cent) said that it is highly important, followed by 25 respondents i.e. (25 per cent) said that it is important, followed by 13 respondents i.e. (13 per cent) said that it is somewhat important, followed by 14 respondents i.e. (14 per cent) said that it is unimportant, followed by 10 respondents i.e. (10 per cent) said that it is not at all important. Regarding (Product quality) out of 100 respondents the 50 respondents i.e. (50 per cent) said that it is highly important, followed by 30 respondents i.e. (30 per cent) said that it is important, followed by 10

respondents i.e. (10 per cent) said that it is somewhat important, followed by 8 respondents i.e (8 per cent) said that it is unimportant, followed by two respondents i.e. (2 per cent) said that it is not at all important. Regarding (Price) out of 100 respondents the 52 respondents i.e. (52 per cent) said that it is highly important, followed by 44 respondents i.e. (44 per cent) said that it is important, followed by four respondents i.e. (4 per cent) said that it is somewhat important, followed by no respondents i.e. (0 per cent) said that it is unimportant, followed by none respondent i.e. (0 per cent) said that it is not at all important. Regarding (Taste) out of 100 respondents the 45 respondents i.e. (45 per cent) said that it is highly important, followed by 43 respondents i.e. (43 per cent) said that it is important,

followed by 10 respondents i.e. (10 per cent) said that it is somewhat important, followed by 2 respondents i.e. (2 per cent) said that it is unimportant, followed by 0 respondents i.e. (0 per cent) said that it is not at all important. Regarding (colour) out of 100 respondents the 30 respondents i.e. (30 per cent) said that it is highly important, followed by 39 respondents i.e. (39 per cent) said that it is important, followed by 13 respondents i.e. (13 per cent) said that it is somewhat important, followed by 11 respondents i.e. (11 per cent) said that it is unimportant, followed by 7 respondents i.e. (7 per cent) said that it is not at all important. Therefore, product should be design in a manner the rational consumer may take decision to choose counterfeit products.

Table - 3 : Factors responsible for buying counterfeit fast moving consumer goods food products

Factors	Frequency						Percentage				
	Highly important (1)	Important (2)	Somewhat important (3)	Un important (4)	Not at all important (5)	Total	Highly important (1)	Important (2)	Somewhat important (3)	Un important (4)	Not at all important (5)
Product design	38	25	13	14	10	100	38	25	13	14	10
Product quality	50	30	10	8	2	100	50	30	10	8	2
Price	52	44	4	0	0	100	52	44	4	0	0
Taste	45	43	10	2	0	100	45	43	10	2	0
Color	30	39	13	11	7	100	30	39	13	11	7
Total	215	181	50	35	19		215	181	50	35	19

• **Perception of respondents on brand reputation towards counterfeit fast moving consumer goods food products**

Table 4 represents Factors responsible for buying counterfeit fast moving consumer goods

food products. Regarding (logo and text) out of 100 respondents the 20 respondents i.e. (20 per cent) said that it is highly important, followed by 22 respondents i.e. (22 per cent) said that it is important, followed by 25 respondents i.e. (25 per cent) said

that it is somewhat important, followed by 15 respondents i.e. (15 per cent) said that it is unimportant, followed by 18 respondents i.e. (18 per cent) said that it is not at all important. Regarding (brand name) out of 100 respondents the 24 respondents i.e. (24 per cent) said that it is highly important, followed by 31 respondents i.e. (31 per cent) said that it is important, followed by 20 respondents i.e. (20 per cent) said that it is somewhat important, followed by 16 respondents i.e. (16 per cent) said that it is unimportant, followed by nine respondents i.e. (9 per cent) said that it is not at all important. Regarding (Packaging) out of 100 respondents the 32 respondents i.e. (32 per cent) said that it is highly important, followed by 22 respondents i.e. (22 per cent) said that it is important, followed by 23 respondents i.e. (23 per cent) said

that it is somewhat important, followed by 13 respondents i.e. (13 per cent) said that it is unimportant, followed by 10 respondents i.e. (10 per cent) said that it is not at all important. Regarding (physical shape & size) out of 100 respondents the 32 respondents i.e. (32 per cent) said that it is highly important, followed by 25 respondents i.e. (25 per cent) said that it is important, followed by 18 respondents i.e. (18 per cent) said that it is somewhat important, followed by 13 respondents i.e. (13 per cent) said that it is unimportant, followed by 12 respondents i.e. (12 per cent) said that it is not at all important. Therefore, brand value, logo, packaging style and physical size, of the product matter. Hence, to give more popularity and promotion for extending coverage these attributes should be design in perfect manner.

Table - 4 : Perception of respondents towards counterfeit fast moving consumer goods food products

Factors	Frequency						Percentage				
	Highly important (1)	Important (2)	Somewhat important (3)	Un important (4)	Not at all important (5)	Total	Highly important (1)	Important (2)	Somewhat important (3)	Un important (4)	Not at all important (5)
Logo & text	20	22	25	15	18	100	20	22	25	15	18
Brand name	24	31	20	16	9	100	24	31	20	16	9
Packaging	32	22	23	13	10	100	32	22	23	13	10
Physical shape & size	32	25	18	13	12	100	32	25	18	13	12
Total	108	100	96	57	49		108	100	96	57	49

CONCLUSION

The present study was carried out to study the consumer perception towards counterfeit fast moving consumer goods food products in rural areas of Prayagraj.Counterfeit organizations should ensure best pricing policies and product quality as

these were identified as the most important factors affecting the perception level of the respondents towards buying counterfeit fast moving consumer food products.Study revealed that the respondents prefer cold drinks the mostly in counterfeit fast moving consumer goods food products, which can

be explored further.Packaging of the products should be attractive and innovative enough to attract the customers as it was identified as the important factor influencing consumer purchase decision.

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RECORD OF THE UROSTYLIS FARINARIA DISTANT, 1901 (HEMIPTERA, PENTATOMOIDEA, UROSTYLIDIDAE) AFTER A CENTURY FROM ASIAN REGION

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ABSTRACT

Through the present manuscript, we are reporting the presence of *Urostylis farinaria* Distant, 1901, for the first time from Indian subcontinent. Earlier this bug was previously reported from south-east Asian country Myanmar only in 1901 by W. L. Distant. The specimen was collected during the field surveys in Ranipur Wildlife Sanctuary, Chitrakoot Uttar Pradesh of India. The presence of *U. farinaria* in India revealed the range extension and long-distance dispersal abilities of the species. Here we discuss the taxonomy, ecology and possible route of dispersal of the species into India.

INTRODUCTION

The genus *Urostylis* Westwood, 1837 mainly found in the Indo-Pak region and throughout the eastern and southern Asia Schuh & Slater, 1995; Rider et al., 2017), 12 species reported in the Palaearctic Region (Rider, 2006; Aukema et al., 2013), 8 species from oriental region (Distant, 1902). Taxonomic review of the genus *Urostylis* from Korean Peninsula given by Kim *et al.*, 2018. As far Indian fauna *Urostylis* occurs mostly in the North India, so it confirms the possible route of dispersal of *Urostylis* between the Palaearctic and Oriental Region. *Urostylis farinaria* Distant, 1901 last time was reported by the Distant, 1902 from Myanmar. After the 117 years *Urostylis farinaria* made their extension from Myanmar to North India it shows the

adaptation of species between the two climatic different countries and its extension. In this study we compared the morphological variation in the species during the century (Table 1).

MATERIALS AND METHODS

The Ranipur Wildlife Sanctuary (WLS) is located in Chitrakoot district of Uttar Pradesh. The total area of the WLS is about 263 sq.kms and nestled in the Vindhyachal range. Much of the area is covering by moderately to dense forest cover with undulating mountains which provide a habitat for wildlife to flourish (Fig. 1 and 2). The northern region of the sanctuary is covered by dense, deciduous forest and the bordering with Ooshan River. The vegetation in the WLS is largely represented by tree species such as Tendu, Mahua,

Dhaak, Gooseberry, Wood Apple, Saal etc. However, the other species which makes the area suitable habitat for avian fauna includes Arjun, Jaamun, Goolar, and Khinni Trees in the flat areas of the WLS.

The assignment of conducting faunal survey of the WLS has been entrusted with Zoological Survey of India, Kolkata being a premier organization under the Ministry of Environment, Forest and Climate Change, Government of India. A team of scientists composed of subject matter experts from specialization in different faunal groups conducted a onetime speed survey from 19th to 30th November 2017. The survey was initiated after adopting multi-pronged approach so that maximum area of the WLS can be covered in ten days. Before initiating the survey GIS and remote sensing techniques were adopted for designing sampling efforts.

A total of 41 examples of fauna order Hemiptera were collected during a survey tour to Ranipur, WLS Chitrakoot Uttar Pradesh at various localities like to Hanuman Choki in Ranipur range of Ranipur WLS (Fig. 3) Out of them of *Urostylis farinaria* Distant, 1901, found and pinned

specimens were identified Photograph of the species were taken with the aid of Leica M 205A. The materials examined in this study are now housed in the Zoological Survey of India, Kolkata (ZSIC).

RESULTS AND DISCUSSION

Genus *Urostylis* Westwood, 1837

Urostylis Westwood, 1837:45. Type species by subsequent designation (Distant, 1902:306): *Urostylis punctigera* Westwood, 1837.

Diagnosis: body greenish and shining, with pale setae dorsally and ventrally; ocelli present; first antennal segment longer than length of pronotum; leg slender with erect setae; paramere rod-like shaped, tapering to apex.

Distribution: *Urostylis* currently contains 64 described species Zhou & Rédei, 2018.

***Urostylis farinaria* Distant, 1901**

Urostylis farinaria Distant, 1901: 114.

Diagnosis: Body orange yellow; Eyes red black, 1st joint of antenna equal to the combined length of head and pronotum together; lateral margin of pronotum levigated, small punctures on basal area of pronotum and a fascia present on apical area; scutellum have black spot basal connevixuim joints and black punctures in middle of base, 3 irregular

Table - 1 : Diagnostic characters of *Urostylis farinaria* Distant, 1901 described by Distant, 1902 in and present study.

Urostylis farinaria Distant, 1901 described by Distant	*Urostylis farinaria* Distant, 1901 described in this study
Body orange yellow, sometime brown yellow; apical joints of 3rd, 4th and 5th joint of antenna black; a black spot present near the apical margin of corium; punctures are small and scattered; inner area of corium impuctate. Length 10 to 12mm.	Body orange yellow; Eyes red black, lateral margin of pronotum differ from the pronotum, small punctures on basal area of pronotum, scutellum have black spot basal connexivum joints, 3 irregular black spot present near the apical margin of corium in the row ; apical joints of 3rd (more the 1/3), 4th (1/2) and 5th (whole) joint of antenna black; apical part of last joint of rostrum black; femora and tibia smooth; claws black.

black spot present near the apical margin of corium in the row and two series of punctures on middle area, lateral margin levigate; antennal length 1>2>4>5>3 apical joints of 3rd (more the 1/3), 4th (1/2) and 5th (whole) joint of antenna black; rostrum dark yellow with last joint of apical part black; sternum plate light orange yellow, abdominal segment dark orange, joint of 4th and 5th abdominal segment having a fascia, femora toothed and tibia smooth; claws black; membrane hyaline with 11 longitudinal veins; genital plate light brown (Fig 4A & 4B).

Distribution: India, and Myanmar.

Remark: New to India.

Figure - 1 : Forest density cover map of Ranipur WLS

Figure - 2 : Map showing line transects used for faunal resource assessment Chitrakoot in Ranipur WLS Chitrakoot

Figure - 3 : Habitat picture near to Hanuman Choki in Ranipur range of Ranipur WLS

***Urostylis farinaria* Distant, 1901**

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MOTHS AS THE POLLINATOR

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ABSTRACT

Pollination, the process by which pollen is transferred from anthers to stigmas and is mostly carried out by animals, is essential to nearly all terrestrial ecosystems. Moths, the polyphyletic groups of insects represent more than 90% of the earth's lepidopterans. Moths have high ecological values. Beyond the aspect of pests, they have an essential role in pollination in Agriculture. Some of the plant species like Yucca, tobacco etc. are highly dependent on moths for their pollination. Even the existence of Yucca plant species completely depends on the Yucca Moth. Pollen transfer by moths may play an essential role in enabling genetic variation in plant communities across landscapes. These pollinating insects are generally attracted to nighttime blooming with white or pale-colored flowers that are aromatic and have a large amount of diluted nectar. Some moth pollinators are active during the day as well as at night. There are several moth families (likeGeometridae, Erebidae, Noctuidae etc.) which are high potential for several plant families (like Fabaceae, Rosaceae and Ericaceae etc.). Pollen is transferred more efficiently on the ventral thorax, or chest ofmoth than on the proboscis, or tongue. Moth numbers are declining, and we are learning more about how crucial they are for pollination, which emphasizes the need to include these nocturnal pollinators in pollinator conservation initiatives.

INTRODUCTION

Almost all terrestrial ecosystems depend on pollination, which is the transfer of pollen from anthers to stigmas, primarily carried out by animals. The sustainability and protection of the world's flora and animals depend on this process. Plant reproductive production is decreased by the loss of pollination services brought on by pests, pesticides, harsh weather, habitat damage, and fragmentation. In severe circumstances, this can result in the extinction of plants and animals, which would eventually alter the ecosystem's function and the surrounding environment (Kevan and Viana, 2003). Moths are insects and comes under the order Lepidoptera. Moths are closely related to butterflies. Lepidoptera has more than 1,65,000 described species (Regier et al., 2009). These polyphyletic groups of insects represent more than 90% of the earth's lepidopterans, and many moth species are still waiting to be discovered and named, mostly from the tropical regions of the world (Heppner, 2008). According to a recent study, 1,65,000 species

of moths have been reported globally, among which 12,000 species of moths have been reported from India (Chandra and Nema, 2007). Generally, they are considered as the pests which is not completely true. They have a wide range of distribution and are very important to the ecosystem of the entire world. They are an important component of terrestrial ecosystems, acting as plant pollinators, herbivores of crops and wild plants, and prey for many rodent, bird, and bat species (Regier et al., 2009; Bates et al., 2014).

Since pollinators play a key role in plant reproduction, which is the primary means of achieving sustainable productivity, pollination is essential to the operation of nearly all terrestrial ecosystems, including those affected by agriculture (Kevan,1999).

On the other hand, pollination is essential to the survival of our ecosystems. More than 90% of the world's wild blooming plant species, as well as more than 75% of food crops and 35% of the world's agricultural area, rely totally or partially on animal pollination. Pollinators are essential to biodiversity conservation in addition to their direct contribution to food security. There have been startling decreases in the variety and quantity of insects in insect populations, by up to 75% in less than 30 years (Singh, 2021).

Moths as Pollinators:

Pollination is an important plant-animal interaction in ecosystems, and moths (Lepidoptera) are a common and diverse group of flower visitors(Kearns et al., 1998).Like other pollinators, moths and plants co-evolved, and as a result, both moths and plants today display traits tailored to one another(Haase, k.,2020).On the basis of recent scientific studies, now they are not completely called pests, they have high ecological and economical values. They can act as Pollinators for numerous flowering and non-floweringplant species

of different plant families. According to many recent scientific studies, the members of Geometridae (Geometer moths), Erebidae (Erebid moths, Tiger moths, Lichen moths), Noctuidae, Sphingidae and Crambidae families have a high potential for pollination. Moths interact with 47 distinct plant species, which is more than bees or butterflies.The Fabaceae, Rosaceae and Ericaceae families of plants are more common with moth pollination (Walton, R.E. *et al* 2020 and Singh, N., 2022).
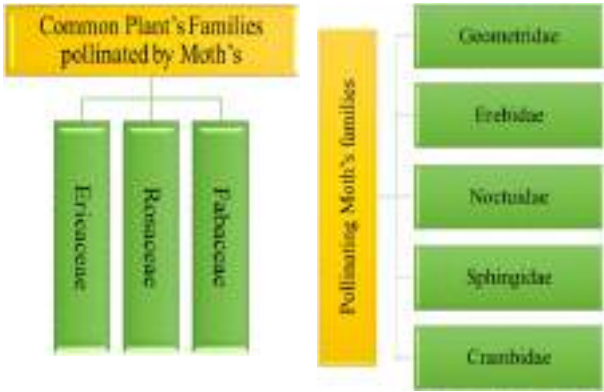
(Walton RE. et al 2020 and Singh, N., 2022)

Pollen transfer by moths may play an essential role in enabling genetic variation in plant communities across landscapes, as adult moths travel considerably greater distances between patches of plants than bees, who forage around a fixed nest spot i.e**.** moths play an important role in the long-distance transfer of pollen among plants.They also help to fill in the gaps by serving as a natural biodiversity backup.Moths take up the night shift for pollination after dark. These pollination insects are drawn to nocturnal blooms with pale or white blossoms that are fragrant and have enormous amounts of dilute nectar but some lepidopterans secrete saliva to dilute heavy syrupy nectars and thus enable imbibition like*Plusia gamma*(Proctor and Yeo1973).The Flower with white or pale colour reflects moonlight, allowing nocturnal pollinators to view them from a distance.

Many moth species, on the other hand, visit a number of different plant species for nectar, the majority of which have no link to the plants their caterpillars feed (Haase, k.,2020). Some moth pollinators are active during the day as well as at night. Yellow flowers draw a wide range of visitors and are frequently quite reflecting.

Moths frequently visit the following flowers (United States Department of Agriculture):

- In clusters and provide landing platforms

- White or dull colors

- Open late afternoon or night

Furthermore, moths visit flowers that release their most pungent odors at night, which many daytime pollinators miss, such as creeping buttercup and honeysuckle. Moths are also not afraid to work for their food, visiting flowers containing deeply concealed nectar, such as morning glory, tobacco, yucca, and gardenia (Schueman, L.J, 2022).

The numerous Plusia species, which can occasionally be seen in huge numbers, and the hummingbird hawkmoth (Macroglossa), which is active throughout the day, are significant pollinating moths. *Tegeticula maculata*, a little moth, is an intriguing instance. It is completely reliant on yucca blooms, where its larvae grow in the ovules.

Yucca is an excellent example of a plant-pollinator connection that is mutually beneficial: Yucca plants are pollinated primarily by yucca moths of the species Tegeticula or Parategeticula, and their caterpillars eat only yucca seeds. Female yucca moths actively pollinate the blossoms. They take pollen from the plant where they mated, fly to another yucca species, deposit the pollen, and lay their eggs. Plants and pollinators have such a strong association that several yucca plant species need a single species of moth to complete their life cycle and vice versa(Haase, k.,2020).

Ovipositor
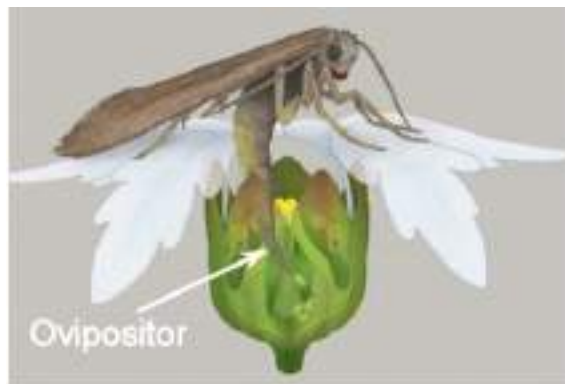
The moth lays her eggs inside the flower's ovary, where the yucca plant will eventually grow its fruit and seeds, providing a safe and nutritious place for the caterpillars to eat and grow (Dewey, C. 2021).

According to several research, pollen is transferred more efficiently on the ventral thorax, or chest, of the moth than on the proboscis, or tongue. While feeding, moths' hairy bodies come into contact with the plant's reproductive organs, resulting in an abundance of rich pollen transferred to the next flowers they visit (Walton R.E., *et al.,* 2020).

Pollinators are in Trouble:

Pollinator numbers are dropping in many regions of the world, mostly as a result of mono-cropping, excessive use of agricultural herbicides, and increased temperatures caused by climate change (Schueman, L.J., 2022). It is also obvious that declining insect variety and abundance are mostly due to human activity. Pollinators that are active during the day and at night suffer a variety of problems, including habitat loss, pesticide exposure, illness, and invasive species. However, light pollution is a distinct threat to nocturnal pollinators. Artificial lights disorient moths, which can interfere with locating mates, avoiding predators, and pollinating plants, according to a study. A study discovered that night time visits to plants were reduced by 62 percent in regions with artificial lighting vs dark areas (Knop, E., 2017). Air pollution from volatile chemicals released by autos and

industrial production can also disrupt the scent-based communication of nocturnal pollinators (Haase, k.,2020).\

(Schueman, L.J, 2022)

Moth's Attraction towards Light
(Image: Dr John Brackenbury/Science Photo Library)

Long-term studies have shown losses in insect biodiversity and abundance worldwide; for instance, 75% decline in Germany's total biomass of flying insects and a 35% decline in the world's abundance of moths over 40 years and butterflies over the previous 27 years (Singh, 2021).

Need for Conservation:

These nocturnal hard workers are critical to the ecological health of our world since 75% of all blooming plant species rely on pollinators for fertilization (Ollerton J.,*et al.* 2011). It is thought that pollinators are responsible for one out of every three pieces of food you eat (Buchmann S., *et al.* 1996 and Klein A.M., et al. 2007). Farms that are nearer to natural areas have higher agricultural yield because more pollinators visit them (Klein A.M., 2007). Pollinators promote healthy ecosystems that clean the air, stabilize soil, protect from severe weather, and support other species in addition to the food humans eat (Costanza, R. *et al.* 1997).

Because of their hairy underbellies, from which researchers gathered pollen samples, the study revealed that moths are better at pollination than previously supposed(Haase, k.,2020).Moth numbers are declining, and we are learning more about how crucial they are for pollination, which emphasizes the need to include these nocturnal pollinators in pollinator conservation initiatives.

Many people don't realise the extent and complexity of the labour that these nocturnal pollinators accomplish, which is sometimes largely unseen to human eyes because it takes place throughout the night. Moths have been underappreciated in terms of their role in pollination, and their conservation has also been devalued. Now is the moment to raise awareness about moths and conserve their habitats with the same energy and urgency that bees, butterflies, and humming-birds have. It is due to their efforts that the earth continues to blossom when most people are sleeping.

Pollinator Conservation:

Over the past decade, pollination conservation problems have begun to gain more attention. Policies that acknowledge the significance of pollinators are still necessary, though. To help conserve moths and other night-active pollinators, keep your garden and other outdoor areas free of unnecessary lighting. Increased efforts are also needed to increase public awareness of the critical importance of plant-pollinator interactions for the preservation of natural resources and agriculture.

Further research is necessary to elucidate the specifics and integrate pollination awareness and management into land management and rural development practices, but overall, there is enough knowledge available to launch initiatives that conserve and sustainably manage pollinators within agroecosystems. The commonly used measurements are as follows (Eardley, *et al.* 2006).

- Natural habitat preservation and restoration.
- Pollinators like to cultivate flowery plants.
- Encouraging diverse farming practices.
- Creating pathways for migrating pollinators to get nectar.
- In addition to crops, provide habitats for food and pollinator nests.
- Promoting integrated approaches to pest management.
- Deterring the improper use of pesticides.

Pollinators and Pollination Awareness:

The following initiatives will increase the capacity for pollinator conservation and restoration while also developing a worldwide awareness of pollinators and pollination; (Eardley, *et al.* 2006).

- Set up a broad range of users and audiences with high-quality, easily understood information about pollinators and their conservation.
- Create training and educational outreach initiatives for all communities.
- Using indicators and Deine criteria, assess the state of agricultural production and the risks posed by pollinator losses.
- To certify products as "pollinator-friendly," use international standards organizations.
- Verify that key concerns about pollinator safety are addressed in pesticide labelling.
- Create corporate incentives for pollinator protection (and eliminate disincentives).
- Motivate famous people to raise awareness

about pollinator protection.

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BIOFILMS IN THE FOOD INDUSTRY: UNSEEN CULPRITS LURKING IN OUR FAVORITE EATS: A REVIEW

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ABSTRACT

Biofilms, complex microbial communities embedded within a self-produced matrix, pose significant challenges in the food industry. This review paper comprehensively explores the formation, impacts, detection methods, and control strategies of biofilms in food processing environments. Understanding the intricate nature of biofilms is pivotal for implementing effective preventive measures and control strategies to ensure food safety and quality. Biofilms have garnered significant attention in maintaining food hygiene due to microorganisms' ability to adhere and thrive on food and related surfaces when conditions are favorable. The process of biofilm formation is dynamic, involving diverse mechanisms for attachment and growth. Extracellular polymeric substances play a crucial role in enabling microorganisms to attach and colonize food-contact surfaces. Numerous techniques have been employed to comprehensively explore and manage biofilm attachment. If microorganisms persist on these surfaces, they can foster biofilm formation and increase the risk of transferring contaminants. To counter this, preventive and control strategies such as proper plant layout, equipment design, material selection, appropriate use of detergents, disinfectants, and physical methods are employed to curb biofilm formation on surfaces in contact with food. Moreover, there's a growing recognition of the efficacy of bacteriocins and enzymes in the food industry, offering unique potential for effectively controlling and eliminating biofilms.

INTRODUCTION

Within the field of natural products and the food sector, solid surfaces enriched with nutrients attract microorganisms, providing the necessary conditions for their survival and proliferation. Initially deposited onto these surfaces, these microorganisms subsequently adhere, thrive, and reproduce, forming colonies of cells. Crucially, the creation of organic polymers is vital for facilitating the successful establishment of microorganism colonies (Allison and Sutherland, 1987).As the cell mass grows, it accumulates organic and inorganic matter, nutrients, and additional microorganisms, resulting inthe development of a microbial biofilm. The term "biofilm" denotes the active biological framework consisting of cells and extracellular

substances bound to a solid surface (Bakke *et al*., 1984)**.**As per Costerton*et al*. (1987), a biofilm signifies a functional assembly of microorganisms adhered to a surface, enveloped within extracellular polymeric substances (EPS) synthesized by these microorganisms. The term microbial fouling or biofouling is often used to describe instances where biofilms become troublesome. Biofouling denotes the unwanted accumulation of living microorganisms and their byproducts as deposits on surfaces in contact with liquid substances. In industries such as dairy and food production, biofouling poses significant issues, including hindering heat transfer across surfaces, elevating fluid frictional resistance, and accelerating surface corrosion, thereby causing energy and product losses. For instance, in heat exchangers, biofilms lead to heightened resistance in both liquid flow and heat exchange (Criado*et al*., 1994). Moreover, biofilms, comprising spoilage and pathogenic microflora, formed on food surfaces such as poultry and other meat surfaces, as well as within processing environments, contribute significantly to challenges related to cross-contamination and post-processing contamination.

Mechanisms of Biofilm Formation

The idea that bacteria stick to surfaces isn't new. Early studies using buried slides showed soil bacteria sticking to the slides. Zobell(1943) talked about these slide methods, which was the first time people wrote about biofilms. But it wasn't until the late 1970s that scientists realized this happens everywhere in nature (Costerton*et al*., 1978). Biofilms can grow on almost anything where there are living microorganisms. For most microorganisms, sticking to surfaces—whether living or not, organic or not—is very important for their life and making new copies of themselves. Biofilms happen a lot in water, and scientists have studied how bacteria attach in different places.

Making a biofilm is a process with different steps that keeps changing.

- Conditioning of a surface
- Adhesion of cells
- Formation of micro colony
- Biofilm formation
- Detachment and dispersal of biofilms

Control and removal of biofilms

The control of biofilms represents one of the most persistent challenges within food and industrial environments where the microbial communities are problematic. The biofilms in the food industry can be eliminated by adopting different strategies like physical and chemical methods. In addition, the biological means has been the newer dimension in the recent years for the biocontrol of bacterial biofilms.

Physical methods

Scientists found a way to control biofilms by using a small electric current along with antibiotics. This combo was better at stopping biofilms. The electric current helps push the antibiotics deep into the cells of the biofilm by moving charged molecules around. Even though the antibiotics got into the cells faster and in higher amounts, their ability to kill the bacteria still depended on how fast the bacteria were growing. This showed that how old and active the biofilm was affected how well the antibiotics worked. Using a mechanical method like brushing to clean should still be considered important (Exner*et al*., 1987).

Chemical methods

Treating materials with substances that kill germs has been helpful in preventing bacteria from sticking around, as long as these germ-fighting substances keep coming out of the surfaces. Paints that have silver in them, for example, have been good at stopping groups of bacteria like Legionella pneumophila (Rogers *et al*., 1995). Packaging for

food that has compounds fighting germs has become important recently. These germ-fighting compounds in the packaging move onto the food surface and get rid of germs there. Some examples include using a mix of a type of plastic with an antifungal substance called methyl-1-butylcarbamoyl-2-benzimidazolecarbamate for packaging cheese. Another method is adding an antimicrobial substance like anhydrides or benzoyl chloride into packaging materials to stop mold from growing on food surfaces.

Some beneficial aspects of biofilms

Not all biofilms are bad. In many natural places, they actually help keep water clean by breaking down harmful substances. Bacteria in these biofilms break down toxins, which helps keep pollution levels low, acting as pollution detectors (Fuchs *et al*., 1996). These biofilms made up of different bacteria are used in sewage systems, water treatment plants, and waste gas treatment to clean up water and air. They're also useful for reducing the amount of organic waste in water before it's released or used for farming. Recently, scientists have been using biofilms to clean up industrial waste and in processes to treat wastewater from making nitrogen fertilizer.Biofilms are a natural way to keep cells in place. They're used in machines called bioreactors to make fermentation processes better. These biofilms are also used to make things like acetic acid, ethanol, and other industrial products (Macaskie*et al*., 1995). Even inside our bodies, certain bacteria in our gut help protect us from harmful bacteria and keep a healthy balance in our digestive system. These helpful bacteria, when consumed through fermented foods, also provide health benefits (Johannsen*et al*., 1993)

CONCLUSIONS

Previously, significant efforts have been dedicated to exploring various aspects of biofilms. However, there remains a dearth of practical insights concerning the sampling and quantification of bacteria from dairy and food contact surfaces. There's a crucial need for experiments focusing on microorganism attachment in food processing environments that replicate real-world conditions. Such studies are essential to comprehensively understand the interplay between living organisms and inanimate surfaces in food processing settings. They aid in accurately assessing the risks posed by spoilage organisms and foodborne pathogens, as well as evaluating the microbiological impacts of cleaning and sanitation procedures.Given the escalating resistance of bacterial biofilms to antimicrobial treatments, novel strategies are imperative for biofilm control. Developing new cleaning agents and disinfectants is crucial for the effective elimination of biofilms. Enzymes and bacteriocins are potential supplements to existing cleaning and disinfection agents, yet further research is necessary to validate their effectiveness against biofilms. Each biofilm issue necessitates a detailed analysis to discern its characteristics, allowing for the formulation and implementation of tailored cleaning and disinfection protocols.

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MICROBIAL BIOPOLYMER: APPLICATIONS IN THE FOOD INDUSTRY

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ABSTRACT

Over the past decades plant biopolymers have been largely used in food industries but it has some negative effects on human beings such as cost-effectiveness, non-degradable and requirement of high infrastructure. Thus we shift to microbial polymers which are biodegradable, renewable, biocompatible, non-toxic, eco-friendly, and can reduce pollution along with decreased production costs. Nucleic acids, saccharides, and amino acids are the building blocks of microbial biopolymers and it is produced by microorganisms such as bacteria, yeast, and mold species. We can produce micro-biopolymers effectively by using different pure cultures, selective laboratory mutants, or genetically modified microorganisms of *Pseudomonas* spp., *Azotobacter spp.*, *Xanthomonas spp., Bacillus spp.,* etc. The microorganisms produced some biopolymers such as polysaccharides, polyesters, polyhydroxy, polyamides, polyanhydrides, and polyphosphate effectively. In the food industry, it has various applications as, thickening, gelling, emulsifiers, stabilizers, coating, packaging, and water-binding agents. To qualify as food additive properties, biopolymers can serve as an antimicrobial, sweetener, and antioxidant material that can improve the quality and properties of food. In the food industry, some of biopolymers like Pullulan, Xanthan, Dextran, and PHA are widely used from the microbes. In this book chapter, we focus on the application of microbial biopolymers in food products and study their future benefits to the food industry.

INTRODUCTION

Synthetic polymers have been tremendously used in our daily lives and it has become a necessity for us. Now we cannot imagine our surroundings without having these polymers. There are several products of these polymers ranging from packaging, clothing, food additives, cosmetics, water treatment chemicals, industrial plastics, absorbents, and so on. On the other side, the use of these synthetic polymers shows harmful effects on our environment because of their non-biodegradable nature and their toxicity. Nowadays, research growing towards environmental sustainability has replaced synthetic polymers with natural biopolymers. Due to their comparable performance to synthetic polymers, biopolymers have been accepted into the market (George et al., 2020). Products of natural biopolymers are environmental concerns that are biodegradable, renewable, biocompatible, non-toxic, and cost-

effective. The biopolymer originates from nature and living organisms andis made up of large single molecules i.e. macromolecules of many repeating units (Ezeoha et al., 2013).Biopolymers are grown through physical, chemical, and biological methods using renewable natural sources such as bacteria, fungi, plants, crops, trees, and their components.At present, a wide range of natural biopolymers are macromolecules that are derived from living organisms and have characteristics such as Cellulose, alginate, chitosan, agarose, guar gum, carrageenan, gelatin, dextran, xanthan, pectin, proteins, peptides, DNA, and RNA (Hang et al., 2018; Sondhi et al., 2018; Bedade et al., 2019). Biopolymers originate from microbes,which makes them a vital role in the food industry (E. Dickinson, 2017)due to their excellent biocompatibility, biodegradability, and the presence of multiple active sites, these novel natural counterparts can be used in food, pharmaceutical, medical, and environmental applications (M. Hassan et al., 2019).Microbial biopolymers can be produced by microbes by fermentation or by polymerization of monomers (Chang et al., 2015).Many microbial biopolymers such as polysaccharides, polyesters, and polyamides are naturally produced by many different types of microorganisms. Microbial Polysaccharides are biological macromolecules composed of monosaccharide units. The unique rheological properties of polysaccharides have led to their widespread use as thickeners, stabilizers, sweeteners, and gelling agents in food production,agriculture, cosmetics, health, and pharmaceuticals (Saha and Bhattacharya et al., 2010; Lorenzo et al., 2012). In the food industry microbial polysaccharides control the ice crystal formation in frozen foods (Lovegrove et al., 2016; Milani and Maleki et al., 2012; Paola et al., 2010; Patel and Prajapati et al., 2013; Patel et al., 2010).Microbial biopolymers are produced by

different microorganisms such as *Pseudomonas spp.*, *Azotobacter spp.*, *Bacillus spp.,* etc. That grows under different growth and nutritional conditions (Green et al., 2002).In this paper, we mainly emphasize the general properties of microbial biopolymers, their applications in the food industry, and their benefits in food production in different forms.

Classification of biopolymers :

Based on the polymer skeleton-Biopolymers can be classified into polyesters, polysaccharides, polycarbonates, polyamides, and vinyl polymers. These groups are again classified into several subgroups based on their origin. (Udayakumar et al., 2021). Depending on the degradability- Biopolymers are divided into biodegradable or bio-based such as microorganisms, plants, and animals, and non-biodegradable or synthetic biopolymers such as amino acids, sugars, natural fats, or oils. Based on the nature of repeating units present in the polymer-They are divided into three groups: polynucleotide (for example, RNA and DNA), polypeptides (amino acid compounds), and polysaccharides, which have been the type most commonly applied in various engineering practices (Kalia et al., 2011). Based on applications- Biopolymers are classified into bioplastics, bio-surfactant, bio-detergent, bio-adhesive, bio-flocculent, etc. (Udayakumar et al., 2021). Based on the thermal condition response-They are differentiated as elastomers, thermoplastics, and thermosets. Finally, based on their composition, they are segregated into three groups: blends, laminates, and composites (George et al., 2020). Based on nature- Biopolymers are classified into natural biopolymers, chemically synthesized biopolymers, and microbial biopolymers (Udayakumar et al., 2021) shown in (Fig.1).
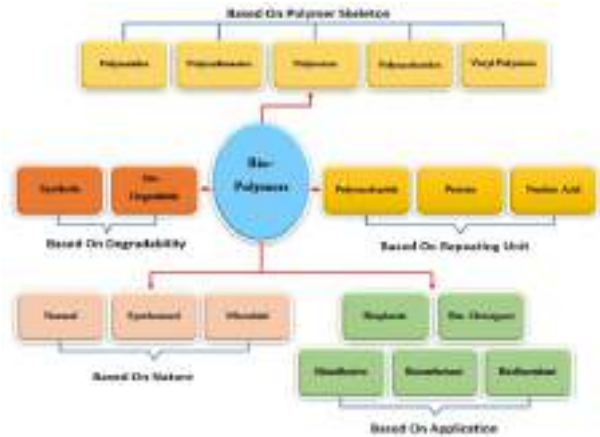
Fig.1. Classification of biopolymers

Production of biopolymers by microorganisms:

The ability of microorganisms to produce spatial types of biopolymers has provided for a wide range of medicaland food industrial applications. In Figure 2 an overall scheme of the microial biopolymer production and purification process is shown the general stages of up- and downstream processing that are compulsoryto achieve the final biopolymer product (Kreyenschulte et al., 2012).
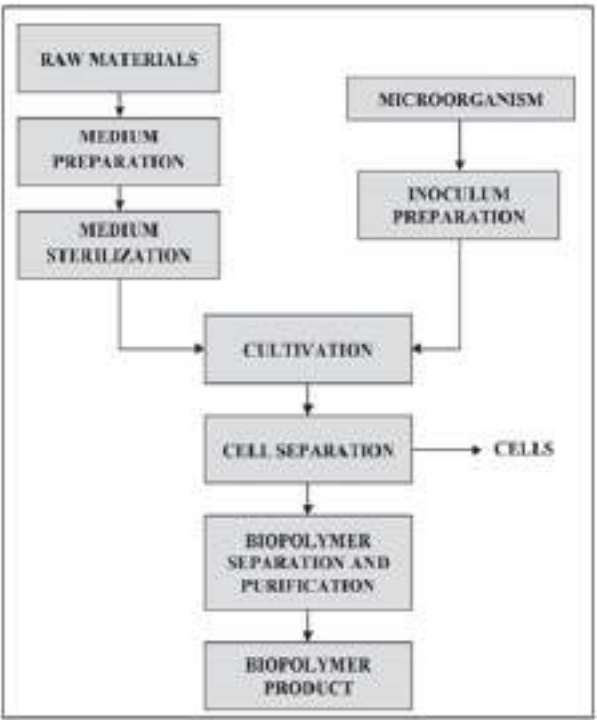

Fig. 2 : Schematic representation of overall microbial biopolymer production and purification (Kreyenschulte et al., 2012).

Table 1 : List of microbes used in the production of Microbial polymers for the food industry:

Polymers groups	Types of Polymer	Structure	Producing Microorganisms	References
Alginates	Polysaccharides	(1-4)β-D-mannuronate and α-L-guluronate	*Pseudomonas spp. and Azotobacter spp.*	Hay et al., 2013; Rehm et al., 2010; Schmid et al., 2015
Bacterial Cellulose	Polysaccharides	Unbranched polymer of β-1→4-linked glucopyranose residues.	*Gluconacetobacter*	Chawla et al., 2009
Curdlan	Polysaccharides	β(1-3)D-glucose	*Alcaligenes faecalis and Agrobacterium sp.*	Rehm et al., 2010; Schmid et al., 2015
Dextran		α(1-6) glucan	*Leuconostoc spp. Streptococcus spp. ,Lactobacillus spp. Gluconobacter sp., Pediococcus Pentosaceus*	Naessens et al., 2005 Patel et al., 2010
Gellan	Polysaccharides	Heteropolysaccharide	*Pseudomonas elodea, Sphingomonas spp.*	Rehm et al., 2010; Schmid et al., 2015

Polymers groups	Types of Polymer	Structure	Producing Microorganisms	References
Pullulan	Polysachharides	α(1-6) glucan	*Aureobasidium pullulans, Tremella mesenterica, Cytaria sp., Cryphonectria parasitica,Rhodototula bacarum*	Goksungur et al., 2011; Schmid et al., 2015
Xanthum Gum	Polysachharides(Exo -polysaccharide)	β(1-4) glucan	*Xanthomonas campestris*	Rosalam et al., 2006
Polyhydroxyalkanoates(PHAs)	Polyesters(Linear)	3-hydroxybutyrate	*Pseudomonas putida, Bacillus megaterium, Pseudomonas aeruginosa, P. stutzeri*	Muneer et al., 2020
-Polyglutamic acid	Polyamides		*Bacillus spp., Staphylococcus*	Rehm et al., 2010; Bajaj and Singhal et al., 2011
Poly- -lysine	Polyamides		*Streptomyces albulus sp.*	Hamano et al., 2011

1. Polysaccharides

The synthesis of polysaccharides by chemical methods is costly and difficult, limited to the production of low molecular weight molecules, and therefore microbial cell factories are necessary to produce them.

1.1 Xanthan Gum

Xanthan gum is produced from the plant pathogenic bacterium *Xanthomonas campestris*, a complex exopolysaccharide. In food industries, it islargely used in various ways such as low-calorie foods,salad dressings, sauces, desserts,gravies, and dairy products. It helps the product's storage capacity by increasing the binding capacity with water in the bakery industry. Xanthan gum can be used as a replacement for eggs and provides a good option for those people who have an allergy to eggs.This way the baked products appear the same as egg-containing products (Sharma et al., 2006).

1.2 Dextran

Dextran is one of the oldest bacterial polysaccharides and it is composed of a group of homo-polysaccharides. The synthesis of dextran carried by *Streptococcus, Lactobacillus,* and some *Weisella* species. In food industries, dextran is used as a texturing agent, emulsifier, preserver, thickener, and stabilizer for frozen foods. Dextran is used as a main ingredient in bakery products and it also possessesthe property to soften foods by improving moisture retention, and preventing crystallization.

1.3 Gellan gum

Gellan Gum is a bacterial polysaccharide and the microorganism involved is *Sphingomonas elodea*. Gellan gums possess a wide range of applications in food industries and they also play an important role in pharmaceuticals, and cosmetics (Luvielmo, et al., 2016).

1.4 Alginate

Alginate is produced by many different species of brown seaweed and two different species of bacteria such as *Pseudomonas* and *Azotobacter*. Alginate has significant physical properties and it is used as a stabilizer, condenser, and gelling agent in the food, paper, and pharmaceutical industries. In the food industry alginate is used as a good food additive and has an E number assigned by Food Standards Agency 2002. Alginates have been used in the food industry asthickening, gelling, stabilizing, and as colloidal agents. The thickening property of alginate helps with moisture retention, acts as a gelling agent, and makes the biopolymer useful for jams, sauces, syrups, and ice creams. Alginates provide the size and shape of the food and give consistency. Alginate is being used in bread and other pastry products, meat, vegetables, and seafood to increase the shelf life and retention of moisture.

Other Biopolymer produced by Microorganisms:

1. Polyesters:

1.1 Polyhydroxyalkanoates (PHAs)

PHAs are linear polyesters and it produced in nature through bacterial fermentation of sugars or lipids. PHAs possess some unique properties such as biodegradability, renewability, and water vapour barrier property due to this it is useful in single-use packaging and is used in PHA-based films showing good characteristics in food packaging.

2 Polyamide

2.1 γ-polyglutamic acid(γ-PGA)

Poly-γ-glutamic acid (γ-PGA) was produced biologically using the *Bacillus subtilis* strain and its compounds useful in food packaging and processing industries(Sung et al., 2005). In the food industry, γ-PGA used to improve the appearance and the texture of products (Bajaj and Singhal et al., 2011).

The most common use of PGA in Japanese traditional food is "**Natto**" in which PGA occurs due to the cultivation of soyabeans with *Bacillus substilis*.

Genetic-engineered Microbial biopolymers:

Genetically engineered products are regulated and modified based on their needs, rather than the method or process by which they are made. Modern biotechnology has given the opportunity to scientists to manipulate revolutionary tools to probes and change pre-existing biopolymers into new products. Recently Food and Drug Administration (FDA) approved that genetically engineered foods are treated the same way as conventional products.Genetically engineered microbial biopolymers such as polyhydroxyalkanoates (PHA) are biodegradable polyesters. In industries, PHAs are produced by genetically engineered from different types of microbes. According to Lee et al., 2000 in this experiment polyhydroxyalkanoate(PHA) is a carbon and energy storage material, it is accumulated inside of various microorganisms under adverse conditions. The most common representative of PHA is poly-β-hydroxybutyrate(PHB), which is formed by a polymerized 3-hydroxybutyrate(3HB) unit. The most common biopolymer is poly (3-hydroxybutyrate (PHB)) is the most studied biopolymer among the many types of microbial PHA (Sekar et al., 2015). PHB microbial biopolymer is not very useful due to its brittle nature so through the process of genetic modification in the *E.coli* or *Ralstonia eutropha*another form of PHB such as P(3HB-co-4HB) copolymer and this copolymer changes the property from hard crystalline to elastic rubber(Saito et al., 1996). Xanthan gum is a polysaccharide produces from microbes and it is widely used in the food industryas

a food thickener but it is also used as a promising agent for enhancement of oil recovery in the petroleum industry. Through recombinant DNA modification of *Xanthomonas campestris* the production of xanthan gumis two-fold and also increases the pyruvate content by over 45% (Tseng et al., 1992).

CONCLUSION

The roles of microbial biopolymers in the food industry are very significant, and the production of microbial biopolymers with the help of microorganisms over plants due to lower costs, easy to developed controlled environmental conditions for production, and also microbial systems devoid of any risks due to seasonal changes. The production of food products from microbial biopolymers is large amount as compared to synthetic biopolymers because microbial biopolymers are eco-friendly and the synthesis process of this biopolymer occursin natural enzymatic pathways, and metabolic pathways, and it is also carried out by the genetically engineered process. Microbial biopolymers developed through biotechnological techniques enable skipping intermediate reactions and help to reduce the production time, increasing the applicability and production cost of microbial biopolymers. The use of microbial biopolymers in food industries reduces manufacturing costs because, at the industrial level, some polysaccharides are not manufactured due to their high cost so through certain modifications in microbial biopolymers such as the uses of enzyme productions or genetic engineering methods we developed useful food products. For the production of cost-effective microbial biopolymers, we use waste products as alternative carbon sources. Consequently, the application of microbial biopolymers in the food industry is rising in the global market. The production of biopolymers through microorganisms decreases the production cost and increases the yields to discard all hazardous synthetic polymers from the food industry.

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FROM PIXELS TO PALATE : THE ART AND SCIENCE OF 3D-PRINTED CUISINE: AN OVERVIEW

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ABSTRACT

Food printing is the technique of transforming a component model into a food product through the deposition of printable food material layer by layer. The printing technology has received keen attention from the industry, public, and academia for its many advantages. One of the recent, innovative, and digital food revolutions gradually gaining acceptance is three-dimensional food printing (3DFP), a technique used to develop products, with the possibility of obtaining foods with complex geometries. The potential advantages of 3D printing technology are being maximized within the food sector include: customized food design, digitalized and personalized nutrition, efficient use of raw material, and expansion of food material source with potential for much more. Additive manufacturing (AM) process is used in 3D food printing which entails computer-controlled addition of material with no human interaction. A 3D food printing technique is composed of liquid binding, selective laser sintering or paste extrusion printing. The food industry is investigating mass customization techniques to meet the individual needs of taste, nutrition, and mouthfeel. Three-dimensional (3D) food printing is a potential solution to overcome drawbacks of current food customization techniques, such as lower production efficiency and high manufacturing cost.

INTRODUCTION

Three-dimensional (3D) food printing is an emerging concept based on the additive manufacturing (AM) technology, which involve the techniques applied layer-by-layer deposition of food materials to print target designs (Mantihal *et al.*, 2020; Pulatsu and Lin, 2021). The additive manufacturing can be categorized into three different technologies which are extrusion, inkjet or binder jetting, and powder binding deposition. Both binder jetting and powder binding deposition methods can be used for providing sophisticated design but have limitations that food inks that have lower viscosity or powder can be used. Compared to binder jetting or powder binding deposition, extrusion-based 3D printing is easier to use and compatible with most food materials so that extrusion-based method is most commonly used and widely studied for 3D food applications (Godoi *et al.*, 2016).

Advantages of 3D food printing include customization and personalization of designs of food and nutritional balances, simplification of food chain, utilization of food wastes and byproducts and

reduced economic costs (Pulatsu and Lin, 2021; Sun et al., 2015; Zhang et al., 2022). Originally, the additive manufacturing technologies were applied using non-food material such as ceramic, plastics and polymers, and involved the application of extreme thermal conditions and organic solvents that should not comply with food safety standards (Pulatsu and Lin, 2021).

Recent advances have led to the development of food material suitable for 3D printing in the food sector. Printable food materials can be categorized in three groups: natively printable materials such as chocolate, non-printable materials such as rice and meats, and alternative ingredients such as insects. Non-printable food materials are materials require specific processing or treatment to make them printable (Pulatsu and Lin, 2021). Printability of the food materials had a significant impact on printing behavior, and it is influenced by ingredient properties and experimental components. The rheological properties of printing materials play a crucial role and food ingredients which have shear-thinning and solid-like behavior are commonly employed in 3D food printing (Demei et al., 2022; Singh et al., 2007). It is also important to modify the printing parameter such as infill density and infill design of designed object in order to optimize the printability of printing materials and ensure structural integrity of the printed objects (Pérez et al., 2019; Pulatsu and Lin, 2021; Sun et al., 2015).

2. 3D food printing techniques:

2.1 Additive manufacturing

The early concept of additive manufacturing, known as rapid prototyping (RP), revolutionized the process of designing, assembling, and fabricating objects using computer-aided design (CAD). Emerging in the late 1980s, RP technology gradually transformed into additive manufacturing (AM), an enhanced version of 3D printing that enables the creation of intricate objects through layer-by-layer construction, utilizing both non-food and food materials (Derossi et al., 2018; Godoi et al., 2016; Mantihal et al., 2020). AM encompasses a range of techniques that involve the sequential deposition of materials to fabricate physical parts or structures. Originally designed for materials like metals, ceramics, and polymers, AM aimed to simplify the fabrication of complex parts in a single step. 3D printing has opened new possibilities in diverse research areas such as medicine, education, and aerospace. One of the significant applications of 3D printing techniques emerged in the realm of food design. Researchers from Cornell University introduced the Fab@Home model 1, an open-source 3D printer specifically designed to create food constructs using liquid food materials. This groundbreaking development showcased the potential of 3D printing to revolutionize the design and fabrication of food with precision and creativity (Godoi et al., 2016).

2.1.1 Extrusion-based 3D printer

In the field of 3D food printing, particularly in extrusion-based 3D printers, a molten or semi-solid viscous system is commonly employed. Hot melt extrusion (HME) is a prevalent technique in which heat is applied to the material within a syringe, adjusting the temperature to control its viscosity and facilitate smooth flow through the nozzle. This method has found extensive application in industries like plastics production and rubber manufacturing and has been adapted for the extrusion of semi-liquid food materials such as pre-tempered chocolate and food purees (Godoi et al., 2016; Mantihal et al., 2020). The advantages of extrusion-based 3D food printing are its simplicity, low cost, ease of operation, and compatibility with food materials (Demei et al., 2022). The process

involves loading a formulated ink composed of food ingredients into a cylinder, commonly referred to as the extruder. The edible ink is then extruded through the nozzle using hydraulic piston force. The deposition of consecutive layers is accomplished by directing the cylinder to predetermined points based on a 3D model. The binding mechanisms during extrusion vary depending on the materials used. The successful extrusion of printing ink relies heavily on the rheological properties of the polymer and the mechanism through which the gel is formed (Godoi *et al*., 2016).

2.1.2 Inkjet printing

In addition to extrusion-based 3D printing, another method commonly employed in 3D food printing is the drop-on-demand ink jet or liquid binder technique, which involves repeatedly binding powdered material together to form a three-dimensional object (Godoi *et al*., 2016; Mantihal *et al*., 2020). In this method, the liquid acts as a crucial binder for the powdered material, enabling the formation of cohesive structures. This technology specifically offers the flexibility to incorporate flavor liquids and colors to bind materials like sugar. One of the notable advantages of this approach is the ability to fabricate unique, complex, and flavorful confectionery products (Hao *et al*., 2010). By utilizing inkjet printing nozzles, droplets of material are deposited on-demand, allowing for precise accumulation and layering of the powdered material. Thermal heads are commonly used in this method, where the print head is heated electrically to generate pressure pulses that propel the droplets from the nozzle. The drop-on-demand liquid binder method is particularly suitable for handling low-viscosity materials. However, due to its limitations with complex food structures, it finds more application in the deposition of materials like chocolate, liquid dough, sugar icing, and similar

substances (Demei *et al*., 2022; Hao *et al*., 2010; Mantihal *et al*., 2020).

2.1.3 Binder jetting

The powder binding deposition method known as Selective Laser Sintering (SLS) is a rapid 3D printing process primarily utilized with powder-based materials (Demei *et al*., 2022; Godoi *et al*., 2016). In this technique, a solid 3D object is formed by selectively fusing the powdered material using a laser as the heat source. The process involves defining a 3D model using specialized software and directing an infrared laser through a scanner to reflect the laser beam onto a printer bed containing the powdered material. The laser scans in a cross-section motion, following the 3D digital description encoded by the software, and fuses the powder particles to construct a solid structure. To build the three-dimensional object, the powder bed is lowered by one layer thickness after each cross-section is scanned, and a new layer of powdered material is applied on top of the previous layer. This layer-by-layer approach allows for the creation of complex 3D structures. Selective Laser Sintering offers several advantages in 3D food printing. It enables the sintering of various materials in powder form, making it a versatile method. The process is faster compared to other techniques since the laser directly interacts with the powdered material without requiring printer bed movement. This makes SLS the second most popular system used in 3D food printing. In addition, SLS can be utilized to generate multiple layers of a food matrix, with each layer containing different food material components (Godoi *et al*., 2016). This flexibility opens possibilities for creating customized food products with varying textures, flavors, and compositions (Severini *et al*., 2016).

3.   Application of 3D food printing

3D food printing has revolutionized the

food industry by offering a wide range of benefits and applications. The key advantage of 3D food printing is its customization and personalization (Pulatsu and Lin, 2021; Severini *et al*., 2016). It allows individuals to have customized meals that cater to their specific preferences and dietary needs. It facilitates the development of customized nutritional requirements, dietary needs and modified texture and structure of food items. Specifically, 3D food printing offers the potential solutions for elderly individuals with chewing and swallowing difficulties, providing modified texture and personalized food options. Furthermore, it allows for on-demand meal production and personalized nutrition in military and space applications (Liu *et al*., 2018; Mantihal *et al*., 2019; Xing *et al*., 2022). Moreover, the creative design possibilities of 3D printing enable the creation of visually appealing and intricate shapes. Furthermore, 3D printing holds promise in addressing food security challenges and sustainability by utilizing alternative food sources. It opens opportunities for incorporating novel ingredients, such as algae or edible insects (Derossi *et al*., 2018; Severini *et al*., 2016), into food products. It can contribute to reducing waste and costs by optimizing resource utilization.]

4. 3D printing materials

Initially, 3D printing technologies were primarily focused on creating three-dimensional objects using non-food materials like metals, ceramics, and synthetic polymers, which involved processes incompatible with food safety standards, such as the use of organic solvents, extreme temperatures, or cross-linking agents (Godoi *et al*., 2016; Pulatsu and Lin, 2021). However, recent advancements have led to the introduction of food-grade materials suitable for 3D printing. There are three categories of printing materials that are applicable for 3D printing. The first category

consists of natively printable materials such as hummus and chocolate, which can be directly used for printing without additional preparation. The second category includes traditionally non-printable materials such as rice, fruits, and vegetables. These materials may require specific formulations or processing techniques to make them suitable for printing such as gelatinization or adding hydrocolloids. Lastly, alternative ingredients such as insect powders are being explored for their potential as printable food materials (Pulatsu and Lin, 2021). These advancements in food inks for extrusion-based 3D printing open exciting possibilities for creating customized and innovative food products.

5. Challenges in 3D printing of food products

The widespread implementation of 3D printing technology in the food sector faces several challenges, which hinder its broad adoption. These challenges include:

5.1 Printing Precision and Accuracy:

The precise and accurate application of 3D printing technology in the food sector is crucial (Hussain *et al*., 2022; Liu *et al*., 2017). While it offers the advantage of creating intricate and visually appealing edible structures that enhance consumer interest and appetite, there is a trade-off between printing speed and precision. Increasing printing speed or using larger nozzles or laser diameters can reduce the precision and resolution of printed objects, presenting unfavourable circumstances for 3D food printing (Pulatsu and Lin, 2021). Therefore, it is essential to find a balance between acceptable printing accuracy and productivity. One potential solution is to adopt larger nozzle diameters and faster printing speeds while ensuring acceptable printing accuracy. Another approach is to use multi-nozzle printers to

fabricate multiple objects simultaneously, thus improving printing productivity (Liu *et al.*, 2017).

5.2 Production of Colorful, Multi-Flavor, and Multi-Structure Products:

The ability to produce 3D edible structures with varying colors, flavors, and textures is desirable but not widely applied. Therefore, more attention should be given to the production of food products with diverse sensory attributes to meet consumer preferences (Hussain *et al.*, 2022; Liu *et al.*, 2017; Pulatsu and Lin, 2021)

5.3 Consumer Attitudes and Perception:

Changing consumer attitudes toward 3D printing is crucial for its acceptance in the food sector (Liu *et al.*, 2017). People may have biases against 3D printing technology, as it is primarily associated with creating non-edible parts and structures in other industries (Godoi *et al.*, 2016). Overcoming these biases and gaining consumer trust are necessary steps for the successful adoption of 3D printing in the food industry.

5.4 Toxicity and Food Safety:

Ensuring the safety of the printer and the materials used in 3D food printing is a critical concern. The potential toxicity of printing materials and their compatibility with traditional food processing methods need to be thoroughly addressed to ensure food safety (Pulatsu and Lin, 2021).

Despite the numerous advantages of 3D food printing, there are still significant challenges that need to be overcome for its widespread customization and application in the food industry. These challenges can be categorized into material-related issues, such as poor ingredient flow behavior affecting structure accuracy, shape stability, and compatibility with traditional food processing methods, as well as concerns regarding safety, throughput, and speed from a process-oriented

perspective (Pulatsu and Lin, 2021). Addressing these challenges is crucial for the successful integration of 3D printing technology in the food sector.

6.   Conclusion and future prospect:

3D food printing has demonstrated its capability of making personalized chocolates and producing simple homogenous snacks. However, these applications are still primitive with limited internal structures or monotonous textures. To achieve consistency in food fabrication, it is necessary to systematically investigate printing materials, platform designs, printing technologies, and their influences on food fabrication. A process model is expected to link design, fabrication, and nutrient control together. With the development of an interactive user interface, food printers may become a part of an ecology system where networked machines can order new ingredients, prepare favorite food on demand, promote user's creativity, and even collaborate with doctors to promote healthier diets.

Food printing may exert a significant influence on various types of food processing. It provides designers/users with enhanced and unprecedented capability to manipulate forms and materials. This versatility, applied to domestic cooking or catering service, can improve the efficiency to deliver high quality and freshly-prepared food products to consumers with personalized nutrition. It is also capable of creating new flavors, textures and shapes to provide entirely new and unique eating experiences.

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A STUDY ON SOCIO-ECONOMIC CHARACTERISTICS OF THE POULTRY FARMERS IN BALRAMPUR DISTRICT OF UTTAR PRADESH

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ABSTRACT

Poultry farming mainly refers to growing and protecting various types of domestic birds commercially,in poultry farming, rearing and management of fowls are done for two purposes, Production of the eggs and Production of meat or flesh. Poultry farming is a profit-making business; its primary focus is on maximum production in less expenditure. For this reason, cross-breeding of local and foreign breeds was started. Cross-breeding aims for raising breeds with desirable traits. The study was carried out in Balrampur District of Uttar Pradesh. Balrampur district was selected purposively for the study. A total of 115 respondents were selected randomly as respondents.Majority of the poultry farmers (52.18%) having middle age group. It was observed from the results that (66.00%) of the poultry farmers belong to nuclear family. Whereas poultry farmers had medium personal localite source use. While maximum number of poultry farmers having experience in poultry farming about 5-10 years. Thisresearch studies the satisfaction levels of farmer's vis-à-vis services being provided by the Integrator andsuggests measures to improve the living conditions of the farmers.

INTRODUCTION

The largest number of poultry population in India is found in Andhra Pradesh followed by Tamil Nadu, Maharashtra, West Bengal, Karnataka, Bihar, Orissa, Kerala, Assam, Uttar Pradesh and Punjab.Some important urban areas like Mumbai, Pune, Nagpur, Kolkata, Delhi, Chandigarh, Bangalore, Chennai, Hyderabad, Shimla, Bhubaneswar, Ajmer etc. are raising poultry through a developed poultry farming systems. And there are many benefits of commercial poultry farming in India. The main benefits are listed below.

➢ Commercial poultry farming in India has created and still creating profitable business opportunity for the Entrepreneurs.

➢ Poultry farming business can provide a great employment source for the job seeking people.

➢ This is such a business in India that can never dry up.

➢ All types of poultry product have a great demand in the market inside India. And

there are no religious taboo about consuming the poultry meat and eggs.

➢ Highly productive local and foreign breeds are available for commercial production.

➢ Required initial investment is not too high. You can start with small scale production and elaborate it gradually.

➢ Bank loans are available throughout the country.

➢ Numerous farms are available and you can easily learn about poultry farming from those established farmers.

For commercial poultry farming in India three systems are suitable according to the condition of India. And the suitable three systems are listed below.

➢ Intensive System,

➢ Semi-Intensive System and

➢ Extensive System.

For commercial meat production business, go with highly meat productive broiler poultry breeds. Contact with your nearest expert poultry producer to learn more about highly productive breeds. Common and mostly raised poultry breeds in India are of three types.

1) Broilers   2) Cockerels   3) Layers

MATERIALS AND METHODS

The study was conducted in Balrampur district is one of the city of the Indian state of Uttar Pradesh and is a part of Devipatan division as well as the historic Awadh regions. There are 75 district in Uttar Pradesh, out of that Balrampur district was selected purposively. Balrampur district Located on the banks of the West Rapti River and Eastern part of Uttar Pradesh, Which is in Upper Gangetic Plain agro climatic region. The district lies between longitude 260. 43" N and latitude – 820 8 E. The net-cropped area in the district as per 2019-2020 statistics was as high as 67 per cent of the total geographical area.The farmers, who were engaged

in poultry farming activities, have been selected as respondents for the present study. A total of 115 respondents were selected randomly as respondents.Keeping in view the objectives and the variables under study, a well structured interview schedule was prepared and pre-tested in a non-study area to locate any ambiguity in the questions. After pre-testing certain modifications were made in the schedule by consulting experts and finalized schedule will be used for data collection.

RESULTS AND DISCUSSION

The result of the study undertaken and the relevant interpretation and discussion in the light of the objectives of the study-

Table - 1 : Age distribution of the respondents

S.No.	Categories	Frequency	Percentage
1.	Young (Up to 35 Years)	38	33.04
2.	Middle (36 to 55 Years)	60	52.18
3.	Old (Above 55 Years)	17	14.78
	Total	**115**	**100.00**

From the above table it is evident that 52.18 per cent respondents were in middle age group 36-55 years. Whereas young age group up to 35 yearsrespondents were 33.04 per cent. While 14.78 per cent respondentswere in old age group above 55 years. This shows that farmers from every type of age group are participating in poultry farming.

Table - 2 : Distribution of the respondents according to their Education.

S.No.	Categories	Frequency	Percentage
1.	Illiterate	18	15.66
2.	literate (Can read and write)	20	17.39
3.	Primary	17	14.78
4.	Junior High School	15	13.04
5.	High School	20	17.40
6.	Intermediate	21	18.26
7.	Graduate and above	4	3.47
	Total	**115**	**100.00**

The table no. 2 shows that 15.66 per cent poultry farmerswere completely illiterate while 17.39 per cent respondents were also illiterate but they can read and write. Whereas14.78 per cent respondents were primary school passed and 13.04 per cent respondents were Junior High School while 17.40 per cent respondents were High School. 18.26 per cent respondents were having education up to Intermediate level and only 3.47 per cent respondents were graduate and above level. It can be derived from the above data that maximum numbers of farmers belong to poor educational background but they are improving their educational status in the study area.

Table - 3 : Distribution of Land holding of the respondents

S.No.	Categories	Frequency	Percentage
1.	Up to 1 ha. (Marginal)	55	47.83
2.	1 – 2 ha.(Small)	35	30.44
3.	Large (Above 2 ha.)	25	21.73
	Total	**115**	**100.00**

From the above table it is evident that 47.83 per cent respondents were marginal farmers where as 30.44 per cent respondents were small farmers while 21.73 per cent respondents were from belongs to large farmers group.

Table - 4 : Type of family wise distribution of the respondents

S.No.	Categories	Frequency	Percentage
1.	Nuclear	76	66.08
2.	Joint	39	33.91
	Total	**115**	**100.00**

The data presented in table showed that most of the respondents (66.08%) were in nuclear family system followed by joint family group with 33.91 per cent respondents respectively.

Table - 5 :Distribution of respondents according to their farming experience

S.No.	Farming Experience	Frequency	Percentage
1.	0-5years	23	20.00
2.	6 – 10 years	43	37.40
3.	Above 10 years	49	42.60
	Total	**115**	**100.00**

Above table shows that 20.00 per cent respondentswere 0-5 yearsfarming experience where as 37.40 per cent respondentswere 6-10 years experience while 42.60 per cent 10 years and above farming experience category.

Table - 6 : Annual income wise distributions of the respondents

S.No.	Categories	Frequency	Percentage
1.	Low(up to Rs. 75,000)	30	26.08
2.	Medium (Rs. 75,001 to 1,50,000)	47	40.87
3.	Large (above Rs. 1,50,000)	38	33.05
	Total	**115**	**100.00**

From the above table it is evident that 26.08 per cent respondents were in annual income group of up to Rs.75000/- whereas 40.87 per cent respondents were in annual income group ofRs. 75001 to 1,50,000 while 33.05 per cent respondents were in monthly income group of above Rs.1,50,0000. Thus, the table reveals that the majority of respondents were enjoying better remunerations, resulting in their higher status in the families as well.

Table - 7 : Distributions of the respondents which Method followed of Brooding.

S.No.	Categories	Frequency	Percentage
1.	Coal /Wood dust	95	82.60
2.	Gas	17	14.78
3.	Electricity	3	2.60
	Total	**115**	**100.00**

The above table shows that majority of the respondents (82.60%) are using coal/wood dust method of brooding in their poultry farm. The wooden dust is the most economical form than gas and electricity. While 14.78 per cent of respondents are using Gas method followed by only 2.60 per cent respondents are using electricity method.

Table - 8 : Distribution type of roofing for the shed

S.No.	Categories	Frequency	Percentage
1.	*Thatched*	27	23.48
2.	*Cemented Sheet*	73	63.47
3.	Fire Proof	15	13.05
	Total	**115**	**100.00**

Hence, the higher 63.47 Percent of the respondents are having cemented sheet roofing for their shed. While 23.48 percent of the poultry farmers having thatched. Whereas 13.05 per cent respondents having fire proof shed for the roofing.

Table - 9 : Extension contact wise distribution of the respondents

S.No.	Personal	Extent of participation					
		Regular		Occasional		Never	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
1.	Village Development Officer	25	21.73	50	43.47	40	34.78
2.	Additional Development Officer	27	23.47	55	47.82	33	28.69
3.	Block Development Officer	15	13.04	59	51.30	41	35.65
4.	Veterinary officer	29	25.21	55	47.82	31	26.95
5.	District Agriculture Officer	21	18.26	51	44.34	43	37.39

It is evident from the table that 21.73 per cent respondents were regularly meeting with Village Development Officer in the study area whereas 43.47 per cent respondents meeting with VLW often while 34.78 per cent never meet with Village Development Officer of the village. It was also found that in the study area, 23.47 per cent respondents were regularly meeting with Additional Development Officer while and 47.82 per cent meet him often and 28.69 per cent never meet with Additional Development Officer of their village.

13.04 per cent respondents were meeting with Block Development Officer regularly while 51.30 per cent met with him on often basis whereas 35.65 per cent never met with Block Development Officer of their block. In case of veterinary officer, 25.21 per cent respondents met with them regularly, 47.82 per cent met him on often basis while 26.95 per cent never met with them. 18.26 per cent respondents met with District Agriculture Officer of their district regularly, 44.34 per cent met him often basis whereas 37.39 never met with him.

Table-10 Distribution of the respondents according to their personal locality sources.

S.No.	Personal localite sources	Information sources utilization	
		Frequency	Percentage
1.	Neighbors	15	13.04
2.	Friends	35	30.43
3.	Family members	5	4.34
4.	Relatives	12	10.43
5.	Other poultry farmers	48	41.73
	Total	**115**	**100.00**

Among the personal localite sources, other poultry farmers were the most important sources of information in poultry farming. While after that most important sources of information were friends.

Table – 4.11 : Mass media communication wise distribution of the respondents

S.No.	Name of sources	Extent of participation					
		Regular		Occasional		Never	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1.	Agri. related programme on Radio	35	30.43	69	60.00	11	9.56
2.	Television	32	27.82	65	56.52	18	15.62
3.	News Paper/ journal/Magazine	34	29.56	55	47.82	26	22.60
4.	Meeting/Group discussion	29	25.21	49	42.60	37	32.17

It is clear from the table that 30.43 per cent respondents were regularly listening Agriculture related programme on radio for information, 60.00 per cent were occasionally listening Radio while 9.56 per cent were never listen Radio to collect the information. It was found that 27.82 per cent respondents were regularly watching the television for information, 56.52 per cent were occasionally watching television while 15.62 per cent were never watching television to collect the information. It was also found that 29.56 per cent respondents were regularly reading Agricultural journal/Magazine for information, 47.82 per cent were occasionally reading Agricultural journal/Magazine while 22.60 per cent were never read Agricultural journal/Magazine to collect the agricultural information. It is also evident from the table that 25.21 per cent respondents were regularly participating in meeting/group discussion, 42.60 per cent were occasionally participating in meeting/group discussion while 32.17 per cent were never participate in meeting/group discussion.

Findings of the Study:-

➢ It was found that majority of the respondents (52.18%) having middle age groups

➢ It was observed that 18.26 per cent of the respondents wereeducated up Intermediate.

➢ It was found that 47.83 per cent respondents

have up to 1 hac. Land

➤ It was found that majority of the respondents (66.08 %) belongs to nuclear family

➤ It was found that 37.40 per cent respondents have farming experience 6 – 10 years.

➤ It was found that 40.87 per cent respondents income where up to rupees Rs. 75,001 to 1,50,000

➤ Majority of the respondents (82.60 %) were followed wood dust for Brooding.

➤ Higher 63.47 Percent of the respondents are having cemented sheet roofing for their shed.

➤ It was observed that respondents have medium level of extension contact.

➤ It was also observed among the respondents 41.73 per cent poultry farmers taking information from other poultry farmers.

➤ It was found that respondents have medium level of mass media exposure

CONCLUSION

It is concluded that majority of the respondents were middle age group, educated up intermediate, main occupation Agriculture and allied sciences having less than 1 hectareland. Mostly belong to nuclear family. It was also founded that majority of the respondents have up to 10 years farming experience medium level of extension contact, have less contact with government officials and medium level of marketing facilities. Overall it appears that the Poultry is one of the fastest growing segments of the agricultural sector in India today. While the production of agricultural crops has been rising at a rate of 1.5 to 2 percent per annum that of eggs has been rising at a rate of 8 percent per annum.

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RELATIONSHIP BETWEEN THE SOCIO-ECONOMIC CHARACTERISTICS OF RURAL WOMEN AND CONSTRAINTS ENCOUNTERED DURING AGRICULTURAL ACTIVITIES

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ABSTRACT

Women play a significant and crucial role in agricultural development and allied fields. The nature and extent of women's involvement in agriculture varies greatly from region to region. But regardless of these variations, women are actively involved in various agricultural activities. The present research study was conducted to explore relationship between the selected socio-economic characteristics of the rural women and constraints faced by them during agricultural activities in Prayagraj district of Uttar Pradesh. From selected district, two CD block were selected by using simple random sampling. From these blocks, five villages from each blockwere selected by using simple random sampling. Similarly, from 10 selected villages 120 respondents were selected by proportionate random sampling. Relationship between the socio-economic characteristics of rural women and constraints encountered by them during agricultural activities the values of coefficient of correlation; the rural women's age wasfound to have a negative and non-significant relationship with constraints encountered by them during agricultural activities. It means that age did not have a significant effect on the constraints encountered by farm women during agricultural activities.

INTRODUCTION

Agriculture can be an important engine of growth and poverty reduction but in many developing countries is underperforming, because women, who play a crucial role in agriculture and the rural economy as farmers, labourers and entrepreneurs, almost everywhere, face more severe constraints. According to Food and Agriculture Organization (2011), women farmers account for more than quarter of the world's population. In Indian society, women have a multi-dimensional role.

Women are the backbone of any developed society. The central role of women in any society

ensures stability, progress and long –term development of a nation. In agriculture sector primary focus is given to only one gender. Male is the dominant decision maker of the industry and benefit seeker of the policies. The kind of farming men practice is highly involved and commercially active, geared towards domestic and international markets. Agriculture sector as a whole has developed and emerged immensely by empowering men with technology. But this emergence is incapable of lifting the status of women labor as an integral part of industry. In a developing country like India, agriculture contributes 13.5 % to the GDP of the economy it provides 55 % employment in the country out of which a good number of work force is shared by women. Role of women in this sector cannot be ignored they comprise 33 % of the agriculture labor force and 48 % of the self-employed farmers.

Apart from all these they are also involved in bringing fodder from field, chaff cutting, feeding and cleaning of cattle, maintaining cattle shed, compost making etc. Women play a significant role in the agricultural labor force and in agricultural activities (ESA, 2011). Most of the contributions made by women to the farm sector also go unaccounted as they are not directly paid. The picture of ruralwomen is that of a submissive, illiterate, ignorant, assess female, who has been trapped in web of traditions and customs. Constraints encountered by rural women also affect by their socio-economic characteristics. Equitable access for rural women to educational facilities would certainly improve their performance and liberate them from their marginalized status in the society. The objective of the study was to know how and which socioeconomic characteristics help to reduce constraints encountered by rural women.

MATERIALS AND METHODS

The present study was conducted in Prayagraj district of Uttar Pradesh. Two CD block (Karchana and Uruwa) were selected randomly by using simple random sampling. From the selected blocks, five villages from each block selected by using simple random sampling. From 10 selected villages 120 respondents were selected by proportionate random sampling. The data were collected by using personal interview schedule. The relationship between constraints encountered by rural women during agricultural activities and the selected independent variables viz., their age, education, marital status, farming experience, land holding, annual income andextension participation, were measured by computing Coefficient of correlation (r).

Correlation Coefficient

The correlation coefficient ('r' value) was used to measure the relationship between dependent andindependent variables. The correlation coefficient between two groups was calculated by using the following formula.

Where r = Correlation Coefficient

X = Independent variable

Y = Dependent variable

n = Total number of respondents

RESULTS AND DISCUSSION

The result of the study showed that the farm women's education (-0.222), farming experience (-0.301), annual income (-0.314), and extension participation (-0.317) were negative and significant relationship with constraints encountered by rural women during agricultural activities. The farm women's age (-0.064 NS) and land holding (-0.036 NS) were found to have a negative and non-significant relationship with their participation in agricultural activities and the farm women's marital status (0.044 NS) was found to have a positive and non-significant relationship.The rural women's marital status was found to have a positive and non-significant relationship constraints encountered by

**Table - 1 : Relationship between the selected independent variables
of rural women with their constraints. n=120**

Sr. No.	Independent variable	Correlationcoefficient (r)		
		Karchana Block	Uruwa Block	Overall
1.	Age	-0.049 NS	-0.082NS	-0.064NS
2.	Education	-0.235*	-0.246*	-0.222*
3.	Marital status	0.055NS	0.072NS	0.044NS
4.	Farming experience	-0.310**	-0.266*	-0.302**
5.	Annual income	-0.321**	-0.335**	-0.314**
6.	Land holding	-0.033NS	-0.039NS	-0.036NS
7.	Extension participation	-0.352**	-0.312**	-0.318**

* Significant at the 0.05 level NS= Non-significant

** Significant at the 0.01 level

them during agricultural activities. It means that marital status did not have a significant effect on the constraints encountered by farm women during agricultural activities. Similar finding was also observed by Bathla S 2019.

CONCLUSION

      The result of this research study showed that the farm women's education, farming experience, annual income, and extension participation were negative and significant relationship with constraints encountered by rural women during agricultural activities, the farm women's age and land holding were found to have a negative and non-significant relationship with their participation in agricultural activities and the farm women's marital status was found to have a positive and non-significant relationship.

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Short Communication

FIRST RECORD OF GLAUCIAS CRASSUS (WESTWOOD, 1837) (INSECTA:HEMIPTERA: PENTATOMIDAE) FROM CENTRAL INDIA

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Bori Wildlife sanctuary is arranged at 22.403° N longitude and 78.08° E, It is located in the northern foothills of the one of the diverse area in (Satpura Range) Hosangabad district of Madhya Pradesh. It is surrounded by Tawa River, sanctuary having well defines diversity with tremendous topography, and the forest of Bori is characterized by the one of the oldest forests (Diwedi, 2003)

Genus *Glaucias* Kirkaldy, 1908

Type Species: *Pentatoma crassa* Westwood, 1837, by subsequent designation (Distant, 1902) Genus *Glaucias* Kirkaldy, 1908 *Zangis* Stal, 1868b: 514 (junior primary homonym of *Zangis Gist*, 1848, Crustacea). Type species by subsequent designation (Distant, 1902a: 221): *Rhaphigaster amyoti* Dallas, 1851, Australia, New Zealand, Pacific Is. *Glaucias Kirkaldy*, 1908b: 124. New name for *Zangis* Stal, 1868.

Ref.: China, 1929 (tax.); Lin & Zhang, 1993a (key); Stichel, 1962a (tax.) (Rider, 2006).

***Glaucias crassus* (Westwood, 1837)**

1837. *Glaucias crassus Westwood: Jn: Hope, F.W. A catalogue of Hemiptera in the collection of the Rev. F W. Hope, M.A. with short Latin diagnoses of the new species.* Pt. 1: 46 pp. London.

2002. *Glaucias crassus* Reider: Chinese Pentatomidae. II. Pentatominae, *Zoosyst Rossica* Vol. 11:140.

Material examined: Madhya Pradesh, Bori WLS, FRH Dhain & around Bori Wildlife Sanctuary, 1 ex., 23.ii.2024, Coll. Sandeep Kushwaha & Party.

Diagnosis: Body drap green, antennae 5 jointed and pale green, 3rd and 4th joint equal annulated at the apex, first joint of antennae not passing the apex of head, eyes brown, anterior margin of pronotom pale yellow, margins having blackly punctuate, connexivum ochraceous laminated, apex of scutellum two yellow spots, legs blonde green.

Distribution: India: West Bengal, and Madhya Pradesh. Elsewhere: Fujian, Guangdong, Guangxi, Henan, Yunnan, and Vietnam.

Remark: New to Madhya Pradesh.

ACKNOWLEDGEMENTS

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Glaucias crassus (Westwood, 1837)

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Paper : Pandey, G.; Pandey, R. and Pant, H., 2003. Efficacy of different levels of *Trichoderma viride* against root-knot nematode in Chickpea (*Cicer aritinum* L.) Ann. Pl. Protec. Sci. 11 (1) : 101-104.
Qasim, S.Z. and Gopinathan, C.K. , 1969. Tidal cycle and the environmental features of Cochin back waters (a tropical estuary), Proc.Indian Acad. Sci. 698 (6) : 336-48.

Report : Pathak, S.C. and Palanisamy, K., 1995. Shrimp and carp aquaculture and the environment in India. *India study report ADB & NACA Publication* : 75 pp. + 45 annex.

Book : Pandey, G. and Pant, H., 2003. Jaiv Proodhyogiki : Anusandhan avum Vikas. Published by *Commission for Scientific and Technical Terminology.* New Delhi, 1-182.

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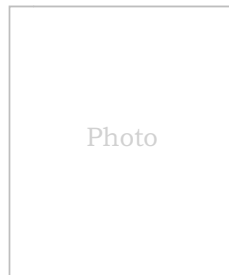
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