Vol. 16 January - June, 2021 No. 1

ABSTRACTED IN CABI, U.K., SHIMAGO, CROSS REF, INDIAN CITATION INDEX AND GOOGLE SCHOLAR, PUBLONS, CITEFACTOR

Journal of Natural Resource and Development

(Peer Reviewed, Refereed Research Journal of Agriculture and Science)

Abbreviated title of Journal : *Jour. Nat. Res. Dev.*

NAAS RATING : 3.77

online @ www.sbsrd.org

SOCIETY OF BIOLOGICAL SCIENCES AND RURAL DEVELOPMENT
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Vol. 16 January - June, 2021 No. 1

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Journal of Natural Resource and Development 16 (1) 1-8, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

PSEUDOMONAS AS BIOREMEDIATION TOOL FOR SOIL CONTAMINATED WITH LEAD AND ZINC

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Received : 18.10.2020 Accepted : 19.11.2020

ABSTRACT

Soil is natural habitat for large number of flora and fauna species, but soil contaminated with different pollutants is not suitable for the growth and development of these species. Contaminated soil is not only effecting growth of plants and microbes but also effecting human health adversely because of direct dependency of human on plants for food so it is now becoming a serious problem. Different methods and techniques have been applied to control and cut of the level of soil pollution. Thought behind this piece of study was that it would be easier to control the level of soil contamination by means of microbes dwelling in the same soil. Aim of present study was to determine the potential of symbiotic association between sunflower (Helianthus annus) and pseudomonas species bacterial species in bioremediation of soil contaminated with Lead (Pb) and Zinc (Zn). Among the different species of Pseudomonas, the present study was restricted to only three species namely P. putida, P. cepacia and P. fluorescens which were inoculated with sunflower. Experimentally contaminated soil was produced by adding solution of lead nitrate ($Pb(NO_3)_2$) and zinc nitrate ($Zn(NO_3)_2$) of 400 mg/l to 20 kg. soil collected from the farm. Experiment was performed on randomized complete block design (RCBD) focused on two heavy metals lead (Pb) and zinc (Zn) and in triplicate in order to conform the experimental results. The experimental findings were that all the three species of pseudomonas i.e. P. putida, P. cepacia and P. fluorescens have the potential to reduce level of Zinc and Lead in the contaminated soil. The potential of bioremediation of Zinc was maximum in P. fluorescence followed by P. Putida and P. cepacia whereas maximum potential for bioremediation of Lead was found in P. cepacia followed by P. putida and P. fluorescence at 8 weeks after plantation. The shoot and root of plants were analyzed for Zn and Pb uptake after 8 weeks. The bio concentration factor (BCF) and translocation factor (TF) determined after 8weeks of plantation. Translocation of Zn from root to shoot by sunflower with Pseudomonas species was higher than Pb. This study concludes that Pseudomonas species contaminated with sunflower has ability of phytoremediation and could be used to remediate contaminated soil with Pb and Zn. In further study there is need to identify combinations of species of other microbes with the plants having phytoremediation ability and to evaluate effect of such treatments on the heavy metal contaminated soil.

Keywords: *Phytoremediation, pseudomonas, helianthus annus*

INTRODUCTION

Soil is the base line of food supply to all organisms of the biosphere. Soil has its natural composition any foreign material added to it which changes its natural property is termed as soil contaminant and soil with altered property is called as polluted soil, which is not suitable for the growth of vegetation and microbes. Due to natural and anthropogenic activities lots of organic and inorganic compounds are being continuously added to soil increasing soil load and making it polluted. Inorganic pollutants especially heavy metals are more dangerous than organic pollutants since organic pollutants can be easily degraded but it is difficult to transform or degrade inorganic pollutants. Natural existence of heavy metals in soil environment is from the pedogenic process of weathering of parent material at level that are regarded as trace (<100 mg/ Kg) [1] and rarely toxic. Concentration of heavy metals in the soil above its defined background level may cause damage and decay to human health, plants, animals and ecosystem. The major sources of increase in the level of heavy metals in the soil are waste water, fertilizers, pesticides, insecticides, metal mining, industrial wastes and air borne sources. There are mainly four causes for the accumulation of heavy metals in the soil these are (I) rate of generation via man made cycle is faster than natural cycle (II) discarded products which are dumped in soil are made up of heavy metals (III) Due to industrial activities heavy metals are transported from the source site to more exposure sites and (IV) added to soil in chemical form as fertilizer, manure, pesticides, insecticides etc [2]. Simple mass balance of the heavy metals in the soil can be expressed as [3]

$$M_{total} = (M_p+M_a+M_f+M_{ag}+M_{ow}+M_{ip}) - (M_{cr}+M_i)$$

Where

M_{total} – Total concentration of heavy metals in soil,

M_p – Contribution from parent material,

M_a – Contribution via atmospheric deposition,

M_f – Portion contributed by fertilizers

M_{ag} – Contribution by agricultural activities,

M_{ow} – Contribution by organic waste

M_{ip} – Contribution by inorganic pollutants,

M_{cr} – Portion of heavy metals removed by cropping

M_i – Portion of heavy metals removed by leaching

Heavy metals contain an ill defined group of inorganic chemical hazards and at contaminated sites most commonly found as Pb, Zn, As, and Se. Like organic compounds it cannot be oxidized to oxides of carbon, above all they do not undergo microbial or chemical degradation and their total concentration persists for longer time after their introduction [7]. Out of the total aerated arable land it is estimated that 20 million hectares are irrigated with waste water and effluents from waste water are percolated into soil. Agriculture based on waste water is contributing 50% of total vegetable supply to urban areas [6]. So irrigation of agricultural land by waste water is contributing much to heavy metal pollution of soil. In present scenario use of fertilizers, insecticides, pesticides and herbicides has been enhanced in order to increase production but the chemicals which have been approved for use of the purpose by most of countries, 10%of them are based on compounds which contain Cu, Hg, Pb or Zn which again contribute to heavy metal pollution. In some part of the world animal waste such as cattle, pig and poultry industry are used to produce manure and applied to agricultural fields either in solid form or as slurries[8], but in poultry and pig industries Cu and Zn are added to their diet as growth promoters in this way manures and fertilizers also contribute to pollution.

Lead (Pb) ranks fifth in industrial production. Mean Pb concentration for surface soil worldwide is

20mg/kg in earth crust [9] but it is ranging up to 67 mg/Kg. this increased Pb soil load is because Pb is released in the form of Pb meatal, Pb (II) ion, lead oxide , lead hydroxides and lead metal oxyanion complexes into the soil. Inhalation and ingestion are the two routes of exposure to living beings and effects from both ways are same. Pb accumulates in body organs which may lead to poisoning or even death. Pb is dangerous because it can affect gastrointestinal tract, kidneys and central nervous system hence it is necessary to control level of lead in agricultural soil. It has been considered to use garden produce grown in soil where total level of lead is lesser than 300 ppm. Zinc is transition metal of 12^{th} group of periodic table with atomic number 30. Zn occurs naturally in soil and permissible level of Zn in soil is 70mg/Kg in crystal rocks [11]. Most of the Zn is added during industrial activities such as mining, coal and waste combustion and steal processing. Zn can interrupt the activity in soil it negatively influences the activity of microorganisms and earth worm thus retarding the breakdown of organic matter [12]. At present time Zn concentration in soil has tremendously increased [13].

Heavy metals as pollutants can be controlled by removing it from contaminated soil because of no possibility of their degradation and transformation. In developed countries techniques such as fixation, leaching, soil excavation, landfill, sequester, techniques are applied to restore the quality of soil and regain its fertility [14]. But these techniques are expensive and in developing countries these are yet to become commercially available. Bioremediation is technique of cleaning the soil by means of plants and microbes which has adapted of growing on contaminated soil. Detoxification mechanisms used in this technique are bioaccumulation, biosorption, biomineralization and biotransformation. Plants and microbes develop tendency to adopt in heavy metal contaminated site can be exploited for bioremediation either in ex-situ or in-situ [15][16]. Sunflower was selected for the purpose because of its ability to grow in poor nutrient soil, simple life cycle, and it can also grow on Pb exposed sites as road side and besides factories producing Pb as waste product.

MATERIALS AND METHODS

Soil samples were collected from the agricultural farm house in proximity to Ramnagar industrial state Varanasi (U.P.), India from depth of 0-15 cm and were carried to laboratory in plastic bags. Samples were air dried and sieved with 2 mm diameter mesh. Samples were subjected to determination of physical and chemical properties along with the presence of heavy metals. Organic matter content was determined using wet oxidation method [17]. K, Mg, Na and Ca were determined by ammonium acetate method [18]. Macrokjedahl analysis was employed for determination of total nitrogen [19]. It was loamy sand texture soil its other physical and chemical properties of soil are reported in table 1.

Addition of Contaminants

Zinc and lead were added as contaminant to the sample in the form of solution of zinc nitrate (Zn $(NO_3)_2$) and lead nitrate (Pb $(NO_3)_2$). 1.599 gm of Pb $(NO_3)_2$ and 2.896 gm of Zn $(NO_3)_2$ was dissolved in 1liter distilled water in order to make stock solution. 40ml stock solution was diluted to 100 ml with aim to achieve concentration ratio of 400mg/dm^3. Thisdiluted 100 ml solution was added to 20 kg soil in pots to attain upper critical soil concentration for both lead and Zinc [20].

Experimental Set Up

Experimental was set up on randomized complete block design (RCBD), three species of pseudomonas were replicated thrice to make 18

experimental pots. Stock solution with concentration of 400mg/Kg was added to each sample in order to contaminate the sample with heavy metals (Zn and Pb). Ten seeds of sunflower (Helianthus annus) inoculated with Pseudomonas were planted in each plot, germination started nearly after one week of plantation and it was monitored regularly for 8 weeks. After 8 weeks of plantation plants were harvested and separated into root and shoot and each part was then dried in oven at 70^0C. Soil of the pot was analysed for heavy metals.

Determination of Lead(Pb) and Zinc(Zn)

Yusuf etal [21] method was applied to determine Pb and Zn. One gram of dried sample was transferred to 50 ml beaker. 10 ml mixture of acids HNO_3, H_2SO_4 and $HClO_4$ in the ratio of 1:1:1 (analytical grade) was added. Covered with watch glass and left over night. Mixture was digested at 70^0C and volume of the solution was reduced to 4ml. Once again 10 ml mixture of acids were added and again volume was reduced to 4ml. Content of the beaker was cooled and filtered to the filtrate distilled water was added to make up volume of 50 ml. Atomic absorption spectrometer (Systronic AA320N) was used to determine concentration of lead (Pb)and zinc (Zn).

5 gram of soil was transferred to 100 ml plastic bottle. 50 ml of 0.1 m HCl was added and shaken for 30 minutes. Soil suspension was filtered and concentration of lead (Pb) and Zinc (Zn) was determined by atomic absorption spectroscopy.

Determination of Bio Concentration Factor (BCF) and Translocation Factor (TF)

Bio concentration factor and translocation factor was calculated by using the formula as [22]

$$BCF = \frac{\text{Average metal concentration in whole plant (mg/Kg)}}{\text{Metal concentration in soil (mg/Kg)}}$$

$$\text{Translocation Factor (TF)} = C_{aerial} \times 1/C_{root} = \frac{C_{aerial}}{C_{root}}$$

C aerial = Metal concentration in the aerial part of plant (shoot).

C root = Metal concentration in root of plant

RESULTS AND DISCUSSION

Table : 1 Physical and chemical properties of soil sample collected from agricultural land form from the nearby area of Ramnagar industrial estate.

Parameters	value
Silt (50-2µm)%	11
Clay(< 2 µm)%	4.8
texture	Loamy sand
pH	6.20
Organic matter (mg/Kg)	3.21
Total N (mg/Kg)	5.86
Available P (mg/Kg)	6.01
Ca (mg/Kg)	430
Mg (mg/Kg)	175
Na (mg/Kg)	0.84
K (mg/Kg)	80.4
Pb (mg/Kg)	849
Zn (mg/Kg)	38.01

Contaminated soil sample bioremediated with different species of pseudomonas in association with sun flower (Helianthus annus) showed significant decrease in concentration of Zinc (Zn) and Lead (Pb). At 8 weeks after plantation (8WAP) concentration of Zn has reduced to desirable level (represented in table 2 and figure1). Though all the pseudomonas species used for the purpose showed the potential of bioremediation, but sunflower inoculated with P. cepacia was most effective for bioremediation of Zn followed by P. putida and P. fluorescens.

While in case of lead (Pb) results at 8 WAP indicates that concentration of Pb in contaminated soil sample remediated with sunflower inoculated with P. putida was found at minimum level followed by P. fluorescens and P. cepacia. Concentration of lead was fond higher in soil sample which was solely remediated by sunflower and reported maximum in non remediated sample (shown in table 3 and fig. 2).

Table : 2. Concentration of Zinc in Contaminated soil Sample 8 week after plantation

Combination used	Concentration of Zn in (mg/Kg)
Helianthus annus+ P. putida	23.65
Helianthus annus+ P. cepacia	19.01
Helianthus annus + P. fluorescens	30.04
Helianthus annus only	32.02
Soil Control	37.24

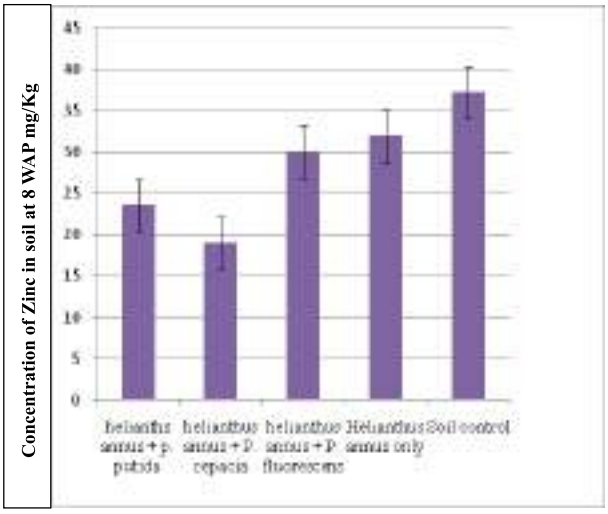
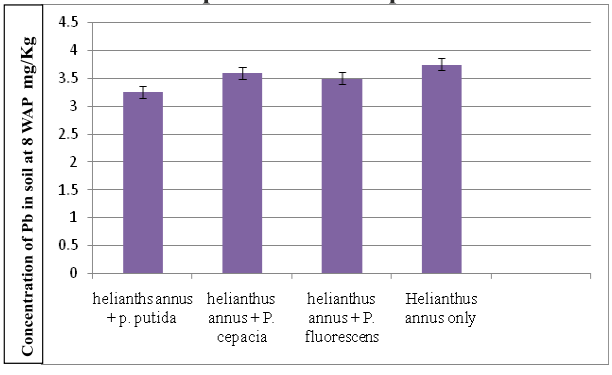


Figure : 1. Concentration of Zinc in Contaminated soil Sample 8 week after plantation

Table : 3. Concentration of Lead in Contaminated soil Sample 8 week after plantation

Combination used	Concentration of Pb in (mg/Kg)
Helianthus annus+ P. putida	1.98
Helianthus annus+ P. cepacia	4.65
Helianthus annus + P. fluorescens	2.35
Helianthus annus only	7.05
Soil Control	8.45

Figure : 2. Concentration of Lead in Contaminated soil Sample 8 week after plantation



Aim for using sunflower plant solely as bioremediation tool in one of the experimental setup in case of both Zn and Pb was to find out role of pseudomonas species in translocation and results of the experiments indicate that concentration of Pb in the root of un-inoculated sunflower plant was higher in comparison to the inoculated plants i.e. sunflower with pseudomonas species accumulates more lead where as for Zinc also it was found that concentration of Zn in un-inoculated plant was lower than the root of sunflower inoculated with pseudomonas species (represented in table 4 and figure 3 and figure 4)

Table : 4. Concentration of Zinc and Lead in rot and shoot of sunflower plant inoculated with different species of pseudomonas

Combination used	Concentration of Zn in mg/Kg		Concentration of Pb in mg/Kg	
	Root	Shoot	Root	Shoot
Helianthus annus+ P. putida	1.01	2.94	3.25	1.45
Helianthus annus+ P. cepacia	1.52	1.75	3.60	1.46
Helianthus annus + P. fluorescens	0.94	1.23	3.50	1.35
Helianthus annus only	0.52	1.45	3.75	1.56

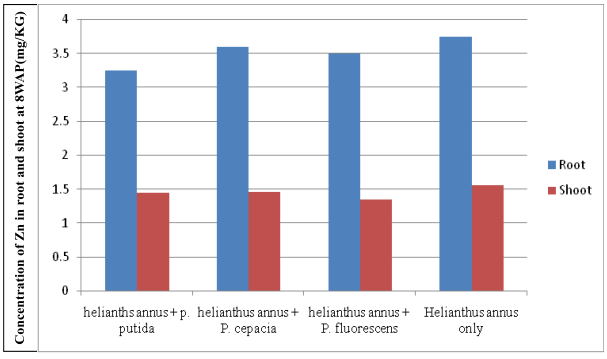


Figure : 3. Concentration of zinc (mg/Kg) in root and shoot of sunflower inoculated with different species of Pseudomonas

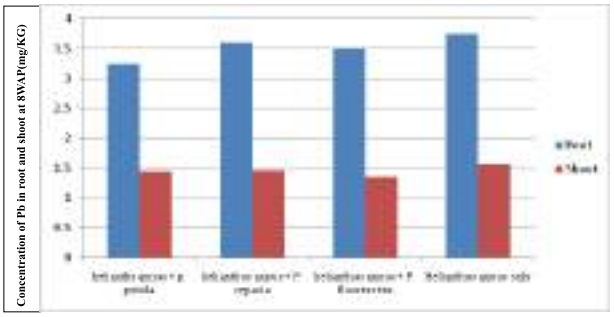


Figure : 4. Concentration of Lead (mg/Kg) in root and shoot of sunflower inoculated with different species of Pseudomonas

Bio Concentration Factor and Translocation factor:

Present study also evaluated the ability of sunflower inoculated with pseudomonas species to accumulate metal from contaminated soil. Data of BCF and TF is represented in table 5.

Table : 5. Bio Concentration Factor and Translocation Factor of Zinc and Lead

Treatment	BCF of Zn	TF of Zn (shoot)	BCF of Pb	TF of Pb (shoot)
Helianthus annus+ P. putida	0.14	2.65	2.20	0.39
Helianthus annus+ P. cepacia	0.16	1.00	0.71	0.36
Helianthus annus + P. fluorescens	0.12	7.90	1.66	0.35
Helianthus annus only	0.04	4.6	0.84	0.37

In case of Pb polluted soil highest BCF was recorded for the polluted soil remediated with sunflower inoculated with p. putida and the least was recorded for the Pb polluted soil remediated with sunflower without any inoculation of pseudomonas species and highest TF value was also observed for the Pb polluted soil remediated with sunflower inoculated with P. putida followed by P. cepacia, P. fluorescens and sunflower without any inoculation. Similarly in case of Zn highest BCF value was observed for the Zn polluted soil remediated with sunflower inoculated with P. cepacia and highest TF was observed for the sunflower inoculated with P. putida followed by sunflower by P. putida, p. fluorescens and uninoculated sunflower plant has least value. For Zn value of TF is greater than 1 in all four cases where as in case of Pb for all the four cases TF value is lesser than 1.

Results of the present study are in accordance with earlier studies asserting that sunflower demonstrated accumulation potential of Zn [23] and pseudomonas has potential of bioremediation. Plants in association with microbes can remove or transform contaminants into harmless substances [14]. Decrease in concentration of Pb and Zn in polluted soil signifies that pseudomonas species enhances the remediation ability of sunflower. Pseudomonas species used for the purpose were not able to translocate Pb from rot to upper part of the plant while these species significantly translocated Zn from root to shoot of the plant. Because of this reason substantial concentration of Zn was reported in above ground biomass in comparison to concentration in root. Major factor deciding the efficiency of phytoextraction in metal contaminated soil is root uptake of heavy metals [24].

CONCLUSION

Present study came to conclusion that bioremediation potential of sunflower can be enhanced by inoculation with Pseudomonas species and this combination can be used for the purpose of bioremediation of soil contaminated with Zinc and Lead both in-situ and ex situ conditions. Sunflower inoculated with P. cepacia remediates best the soil

polluted with Zinc where as sunflower inoculated with p. putida performance was significantly better than rest in soil polluted with Lead. It also records that sunflower inoculated with pseudomonas species accumulates more lead in root and more zinc in shoot. Still there is need to check combination of other species of pseudomonas with other plants on other heavy metal pollutants in order to explore the unexplored facts to check out heavy metal pollution in soil.

ACKNOWLEDGEMENT

Author is deeply thank full to Head, Department of chemistry and Principal Harishchandra Post graduate College, Varanasi for providing laboratory facilities to conduct research work smoothly. Author also express his gratitude to Department of Soil Science, Banaras Hindu University, Varanasi for providing their valuable suggestion whenever it was needed without which it was difficult to complete the work

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Journal of Natural Resource and Development 16 (1) 9-18, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

ON A COLLECTION OFF INSECTA: HEMIPTERA (AQUATIC AND SEMI-AQUATIC) FAUNA OF RAJASTHAN, INDIA

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Received : 25.09.2020 Accepted : 15.10.2020

ABSTRACT

In this study overall of 34 species under 19 genera and 10 families of aquatic and semi-aquatic bugs are so far reported from Rajasthan.

Keywords: *Rajasthan, aquatic and semi-aquatic hemiptera*

INTRODUCTION

Freshwater habitats encompass a wide range of habitats such as rivers, streams, springs, ponds, lakes, pool, temporary puddles, and waterfalls, which eventually makes up only 0.01% of the World's water resource (WCMC, 2000). The biodiversity inhabiting freshwater has particular importance for indigenous people in many parts of the World, who depend upon aquatic products. Of these, the aquatic and semi-aquatic Hemiptera play a significant role in the aquatic food web of aquatic communities and also, they can be utilized as biocontrol agents as well as an indicator of the biological quality of aquatic habitat.

A review of the literature and the current study indicates that a total of 34 species under 19 genera and 10 families of aquatic and semi-aquatic bugs are so far reported from Rajasthan (Andersen, 1981a; Thirumalai, 2002 and 2007).

MATERIALS AND METHODS

Rajasthan, a north Indian State, encompasses most of the Thar Desert and Aravalli range. This state does not have thick forests, and dry. A few rivers flow across the State such as Ghaggar River, Luni River, Chambi River, and Sarasvati River. There are five National Parks and 25 Wildlife Sanctuaries (Source: National Wildlife Database Cell, as per the List compiled as of 24.1.2011 by Dr. J. S. Kathayat).

The samples were collected from different freshwater bodies such as ponds, pools, rivers, lakes, etc. by different parties of ZSI and preserved in 75% ethyl alcohol. The samples were sorted from backlog collection. The same was identified using LeicaM205A stereoscopic binocular microscope. The published literature was reviewed to bring out the current list of aquatic bugs of Rajasthan.

List of water bugs from Rajasthan

Infraorder NEPOMORPHA Popov, 1971

Family BELOSTOMATIDAE Leach, 1815

Subfamily LETHOCERINAE Lauck & Menke, 1961

Genus1. ***Lethocerus*** Mayr, 1853

1. ***Lethocerus indicus*** (Lepeletier-Serville, 1825)

Subfamily BELOSTOMATINAE Leach, 1815

Genus 2. ***Diplonychus*** Laporte, 1833

2. ***Diplonychus annulatus*** (Fabricius, 1781)
3. ***Diplonychus molestus*** (Dufour, 1863)
4. ***Diplonychus rusticus*** (Fabricius, 1781)

Family NEPIDAE Latreille, 1802

Subfamily NEPINAE Latreille, 1802

Genus 3. ***Laccotrephes*** Stål, 1866

5. ***Laccotrephes griseus*** (Gúerin-Méneville, 1844)
6. ***Laccotrephes ruber*** (Linnaeus, 1764)

Genus 4. ***Ranatra*** Fabricius, 1790

7. ***Ranatra elongata*** Fabricius, 1790
8. ***Ranatra filiformis*** Fabricius, 1790
9. ***Ranatra varipes varipes*** Stal, 1861

Family CORIXIDAE Leach, 1815

Subfamily CORIXINAE Leach, 1815

Genus 5. ***Agraptocorixa*** Kirkaldy, 1898

10. ***Agraptocorixa hyalinipennis hyalinipennis*** (Fabricius, 1803)

Genus 6. ***Sigara*** Fabricius, 1775

11. ***Sigara seistanensis*** (Distant, 1920)
12. ***Sigara promontoria*** (Distant, 1910)

Family MICRONECTIDAE Jaczewski, 1924

Subfamily MICRONECTINAE Jaczewski, 1924

Genus 7. ***Micronecta*** Kirkaldy, 1897

Subgenus ***Basilonecta*** Hutchinson, 1940

13. ***Micronecta scutellaris scutellaris*** (Stål, 1858)

Subgenus ***Sigmonecta*** Wróblewski, 1962

14. ***Micronecta quadristrigata*** Breddin, 1905

Family NOTONECTIDAE Latreille, 1802

Subfamily ANISOPINAE Hutchinson, 1929

Genus 8. ***Anisops*** Spinola, 1837

15. ***Anisops barbatus*** Brooks, 1951
16. ***Anisops bouvieri*** Kirkaldy, 1904
17. ***Anisops cavifrons*** Brooks, 1951
18. ***Anisops sardeus sardeus*** Herrich – Shaffer, 1850
19. ***Anisops cambelli*** Brooks, 1951

Subfamily NOTONECTINAE Latreille, 1802

Genus 9. ***Enithares*** Spinola, 1837

20. ***Enithares fusca*** Brooks, 1948
21. **Enithares mandalayensis** Distant, 1910
22. **Enithares unguistris** Zettel, 2012

Genus10. Nychia Stal, 1860

23. ***Nychia sappho*** Kirkaldy, 1901

Family PLEIDAE Fieber, 1851

Genus 11. ***Paraplea*** Esaki & China, 1928

24. ***Paraplea buenoi*** Kirkaldy, 1904

Family OCHTERIDAE Kirkaldy, 1906

Genus 12. *Ochterus* Latreille, 1807

25. ***Ochterus marginatus marginatus*** (Latreille, 1804)

Infraorder GERROMORPHA Popov, 1971

Family GERRIDAE Leach, 1815

Subfamily EOTRECHINAE Matsuda, 1960

Genus 13. ***Amemboa*** Esaki, 1925

26. ***Amemboa*** sp.

Genus 14. ***Onychotrechus*** **Kirkaldy, 1903**

27. ***Onychotrechus rhexenor*** Kirkaldy, 1903

Subfamily GERRINAE Bianchi, 1896

Genus 15. ***Limnogonus*** Stal, 1868

Subgenus ***Limnogonus*** Stal, 1868

28. ***Limnogonus (Limnogonus) fossarum fossarum*** (Fabricius,1775)
29. ***Limnogonus (Limnogonus) nitidus*** (Mayr, 1865)

Genus 16. ***Aquarius*** Schellenberg, 1800

30. ***Aquarius adelaides*** (Dohrn, 1860)

Genus 17. ***Limnometra*** Mayr, 1865

31. ***Limnometra fluviorum*** (Fabricius, 1798)

Family MESOVELIIDAE Douglas & Scott, 1867

Subfamily MESOVELIINAE Douglas & Scott, 1867

Genus 18. ***Mesovelia*** Mulsant & Rey, 1852

32. ***Mesovelia vittigera*** Horvath, 1895

Family VELIIDAE Amyot & Serville, 1843

Subfamily MICROVELIINAE China & Usinger, 1949

Genus 19. ***Microvelia*** Westwood, 1834

33. ***Microvelia (Picaultia) douglasi*** Scott, 1874

Family HYDROMETRIDAE Billberg, 1820

Subfamily HYDROMETRINAE Esaki, 1927

Genus 20. ***Hydrometra*** Latreille, 1796

34. ***Hydrometra greeni*** Kirkaldy, 1898

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Infraorder NEPOMORPHA Popov, 1971

Family BELOSTOMATIDAE Leach, 1815

Subfamily LETHOCERINAE Lauck & Menke, 1961

Genus1. ***Lethocerus*** Mayr, 1853

1. ***Lethocerus indicus*** (Lepeletier-Serville, 1825)

1825. *Belostoma indica* Lepeletier & Serville, *Encycl. Meth.,* **X**: 272.

1924. *Lethocerus indicus* (Lepeletiler & Serville): Hale, *Rec. South Austral. Mus.*, **2**(4): 521.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Gujarat, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* China, Korea, Hong Kong, Japan (the Ryukyu Islands), Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Sri Lanka, Thailand, Vietnam (Goodwyn, 2006; Polhemus and Polhemus, 2013 and Zettel *et al.*, 2017).

Subfamily BELOSTOMATINAE Leach, 1815

Genus 2. ***Diplonychus*** Laporte, 1833

2. ***Diplonychus annulatus*** (Fabricius, 1781)

1781. Nepa annulata Fabricius, *Carol. Ernest. Bokhnii. Hamburgi et Kiloni,* 333.

1961. *Diplonychus annulatus* (Fabricius): Lauck & Menke, *Ann. Ent. Soc. America*, **54**:649.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Distribution: India: Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Bangladesh and Pakistan.

3. ***Diplonychus molestus*** (Dufour, 1863)

1863. *Appasus molestum* Dufour, *Ann. Soc. Ent. France,* **4** (3): 395.

2007. Diplonychus molestus (Dufour): Thirumalai, *Rec. zool. Surv. India. Occ. Pap. No*. **273**: 12.

Material examined: 1♀, Kama- Nathdwara Tehsil, Rajsamand District, 10.ix.2013, Coll. Neena Tak & party.

Distribution: India: Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Tripura, Uttar Pradesh and West Bengal.

4. ***Diplonychus rusticus*** (Fabricius, 1781)

1781. *Nepa rustica* Fabricius, *Species insectorum*, **2**: 333.

2005. *Diplonychus rusticus* (Fab.): Thirumaiai & Suresh Kumar, *Rec. zool. Surv. India*, **105** : 13.

Material examined: 1♂, Guda-Aaskran-Sumer, Pali

Dist., 7.ix.2013, Coll. Neena Tak & party.

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Australia, Cambodia, China, Indonesia, Formosa, Japan, Malaysia, Myanmar, New Guinea, New Zealand, Singapore, Sri Lanka, Taiwan, Thailand, Philippines and Vietnam (Polhemus and Polhemus, 2013 and Zettel *et al.* 2017).

Family NEPIDAE Latreille, 1802

Subfamily NEPINAE Latreille, 1802

Genus 3. ***Laccotrephes*** Stål, 1866

5. ***Laccotrephes griseus*** (Gúerin-Méneville, 1844)

1844. *Nepa griseus* Guerin-Meneville, *Iconoogr. Regne. Anim. Ins., 352.*

1910. *Laccotrephes griseus* (Gúerin-Méneville): Distant, *Fauna British India*, **5**: 314.

Material examined: 1♀, Magar Talao Goal-Sumer, Pali district, Date: 7.ix.2013, Coll. Neena Tak & party.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Myanmar, Seychelles, Sri Lanka and Thailand.

6. ***Laccotrephes ruber*** (Linnaeus, 1764)

1764. *Nepa ruber* Linnaeus, *Mus. Lud. Ulr.,* 165.

1906. *Laccotrephes ruber* (Linnaeus): Distant, *Fauna Brit. India,* **3**: 18.

Material examined: 2♂♂, Forested area on Dholpur- Baddi, 12km from Dholpur city, Dholpur district, 27.ix.2002, Coll: Dr. N.S. Rathore;1♀, Nimjad Sagar, Rajsamand district, 7.ix.2013, Coll: Neena Tak & party.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* China, Japan, Nepal, Pakistan and Taiwan.

Subfamily RANATRINAE Douglas & Scott, 1865

Genus 4. ***Ranatra*** Fabricius, 1790

7. ***Ranatra elongata*** Fabricius, 1790

1790. *Ranatra elongata* Fabricius, *Skrif. Nat. Selesk.,* **1**: 228.

2004. *Ranatra elongata* Fabricius: Thirumalai, *Rec. zool. Surv. India*, **102** (1-2) : 66.

Material examined: 1♂, Andor area, Sheoganj, Sirohi district,7.vi.2013, Coll. Dr. H.S. Banyal.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Australia, Nepal and Sri Lanka.

8. ***Ranatra filiformis*** Fabricius, 1790

1790. *Ranatra filiformis* Fabricius, *Skrif Nat. Selesk.,* **1:**228.

2007. *Ranatra filiformis* Fabricius : Thirumalai, *Rec. zool. Surv. India, Occ. Pap.* **102** (1-2) : 66.

Material examined: 1♀, Kama- Nathdwara Tehsil, Rajsamand District, 10.ix.2013, Coll. Neena Tak & party.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Punjab, Rajasthan,

Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* China, Malay Peninsula, Nepal, Pakistan, Philippines, Sri Lanka and Thailand.

9. *Ranatra varipes varipes* Stal, 1861

1861. *Ranatra varipes* Stal, *Akad. Forh*., **18** : 203.

1998. *Ranatra varipes* varipes: Nieser & Polhemus, *Amemboa*, **2**: 22.

Material examined: 1♂, 1♀, Kama- Nathdwara Tehsil, Rajsamand District, 10.ix.2013, Coll. Neena Tak & party.

D*istribution*: India: Bihar, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Tamil Nadu, Uttar Pradesh, Rajasthan, West Bengal. *Elsewhere:* Australia, Indonesia, Penninsular Malaysia, Myanmar, Singapore, Sri Lanka, Taiwan and Vietnam.

Family CORIXIDAE Leach, 1815

Subfamily CORIXINAE Leach, 1815

Genus 5. ***Agraptocorixa*** Kirkaldy, 1898

10. *Agraptocorixa hyalinipennis hyalinipennis* (Fabricius, 1803)

1803. *Sigara hyalinipennis* Fabricius, *Syst. Rhyn. Brusvigae*, 105.

1995. *Agraptocorixa hyalillipennis* (Fabricius): Polhemus *et al, Cat. Het. Palaeretic region*, **1**: 36.

Material examined: 23 exs., Angor Dam, Angor village, Sirohi district, 8.vi.2013, Coll. Dr. H.S. Banyal.

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Chandigarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Puducherry, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Africa, China, Japan, Myanmar, New Guinea, Pakistan, and Taiwan.

Genus 6. ***Sigara*** Fabricius, 1775

11. *Sigara seistanensis* (Distant, 1920)

1920. *Corixa seistanensis* Distant, *Rec. Indian Mus*., **18** : 206

1995. *Sigara seistanensis* (Distant): Polhemus *et al, Cat. Het. Palaerctic region*, **1** : 50.

Material examined: Recorded from literature (Thirumalai, 2007)

Distribution: India: Himachal Pradesh, Rajasthan, Sikkim, West Bengal.

Subgenus ***Tropocorixa*** Hutchinson, 1940

12. *Sigara promontoria* (Distant, 1910)

1910. *Corixa promontoria* Distant, *Fauna Brit. India*, **5**: 341.

2004. *Sigara (Tropocorixa) promontoria* (Distant) : Thirumalai, *Rec. zool. Surv. India*, **102** : 68.

Material examined: 1♂, 1♀, near Tanot, Jaisalmer, 20.v.2014, Coll: Dr. H.S. Banyal.

Distribution: India: Bihar, Delhi, Karnataka, Odisha, Punjab, Rajasthan, Uttar Pradesh, West Bengal.

Family MICRONECTIDAE Jaczewski, 1924

Subfamily MICRONECTINAE Jaczewski, 1924

Genus 7. ***Micronecta*** Kirkaldy, 1897

Subgenus ***Basilonecta*** Hutchinson, 1940

13. *Micronecta scutellaris scutellaris* (Stål, 1858)

1858. *Sigara scutellaris* Stal, *Öfversigt af Svenska Vetenskaps-Akad: s förhandlingar*,**15**: 319.

1997. *Micronecta (Basilonecta) scutellaris scutellaris* (Stal) : Thirumalai, *Zool. Surv. India. Occ. Pap. No.* **273** : 22.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Distribution: India: Andhra Pradesh, Assam, Bihar, Chandigarh, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere:* Africa, Arabia, Sri Lanka, Southeast Asia, China, Malaysia.

Subgenus ***Sigmonecta*** Wróblewski, 1962.

14. *Micronecta quadristrigata* Breddin, 1905

1905a. *Micronecta quadristrigata* Breddin,

Societas Entomologica, **20**: 57.

2004. *Micronecta (Sigmonecta) quadristrigata* Breddin: Thirumalai, *Rec. zool. Surv. India*, **102**: 70.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Distribution: India: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu and West Bengal. *Elsewhere:* Australia, Iran, Hong Kong, Indonesia, Malaysia, Philippines, Singapore, Sri Lanka, Southeast Asia and Taiwan.

Family NOTONECTIDAE Latreille, 1802

Subfamily ANISOPINAE Hutchinson, 1929

Genus 8. ***Anisops*** Spinola, 1837

15. ***Anisops barbatus*** Brooks, 1951

1951. *Anisops barbata* Brooks, *Kans. Univ.Sci. Bull.*, **34**: 387.

2004. *Anisops barbatus* Brooks: Nieser, *Raff. Bull. Zoology*, **52** : 84.

Material examined: 1♂, 3♀♀, Tanot, Jaisalmer, 20.v.2014, Coll. Dr. H.S. Banyal.

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* China, Indonesia, Myanmar, Singapore, Sri Lanka, Taiwan and Vietnam.

16. ***Anisops bouvieri*** Kirkaldy, 1904

1904. *Anisops bouvieri* Kirkaldy, *Wiener Ent. Zeit.*, **23**: 116.

2007. *Anisops bouvieri*: Thirumalai, *Rec zool. Surv. India, Occ. Paper No.,* **273**: 37.

Material examined: Recorded from literature ((Thirumalai, 2007).

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* China, Indonesia, Malaysia, Myanmar, New Guinea, Singapore, Thailand and Vietnam.

17. ***Anisops cavifrons*** Brooks, 1951

1951. *Anisops cavifrons* Brooks, *Kans. Univ. Sci. Bull.,* **34**: 418.

2007. *Anisops cavifrons* Brooks: Thirumalai, *Rec. zool. Surv. India, Occ. Pap. No.*, **273** : 38.

Material examined: Recorded from literature (Thirumalai, 2007).

Distribution: India: Bihar, Chandigarh, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharshtra, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Pakistan.

18. ***Anisops sardeus sardeus*** Herrich-Shaffer, 1850

1850. *Anisops sardeus* Herrich-Shaffer, *Die wanzenartigen Insecten*, **9:** 41.

2007. *Anisops sardeus sardeus* Herrich-Shaffer: Thirumalai, *Rec. zool. surv. India, Occ. Paper No.*, **273**:41

Material examined: Recorded from literature (Thirumalai, 2007).

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Bihar, Chandigarh, Chhattisgarh, Delhi, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* Afghanistan, Africa, Albania, Europe, Greece (Corfu), Hungary, Myanmar, North Caucasus, Romania, Spain (Canary Islands), Syria and Turkmenistan, Turkey and United Arab Emirates (Brooks, 1951 and Linnavuori *et al.* 2011).

19. ***Anisops cambelli*** Brooks, 1951

1951. *Anisops campbelli* Brooks, *Kans. Univ. Sci. Bull.,* **34**: 322.

2004. *Anisops campbelli* Brooks: Thirumalai, *Rec. zool. Surv. India*, **102** (1-2) : 65.

Material examined: Recorded from literature (Thirumalai, 2007).

Distribution: India: Chandigarh, Gujarat, Harayana, Himachal Pradesh, Karnataka, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere:* Myanmar.

Subfamily NOTONECTINAE Latreille, 1802

Genus 9. ***Enithares*** Spinola, 1837

20. ***Enithares fusca*** Brooks, 1948

1948. *Enithares fusca* Brooks,. *J. Kans. Ent. Soc*, **21** : 46.

2004. *Enithares fusca* Brooks: Thirumalai, *Rec. zool. Surv. India*, **102**(1-2) : 65.

Material examined: 1 ♂, forest department nursery, 4 kms. from Karauli, Karauli district, 22.ix.2002, Coll. Dr. N.S. Rathore.

Distribution: India: Karnataka, Kerala, Tamil Nadu, Rajasthan and Madhya Pradesh.

21. ***Enithares ciliata*** (Fabricius, 1798)

1798. *Notonecta ciliata* Fabricius, *Suppl. Ent. Syst.*, 524.

2004. *Enithares ciliata* Fabricius : Nieser, *Raff. Bull. Zool.*, **52**(1) : 93.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Goa, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Meghalaya, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal. *Elsewhere* : Bhutan, Indonesia, Malaysia, Mauritius, Sri Lanka and Vietnam.

22. ***Enithares unguistigris*** Zettel, 2012

2012. *Enithares unguistigris* Zettel, *Ann. Nat. Mus. Wien*, **113**(B) : 23-26.

Material examined: Recorded from literature (Zettel, 2012).

Distribution: India: Rajasthan.

Genus10. ***Nychia*** Stal, 1860

23. ***Nychia sappho*** Kirkaldy, 1901

1901c.*Nychia marshalli* Sappho Kirkaldy, *Ann. Mus. Genova*, **20** : 809.

2004. *Nychia sappho* Kirkaldy : Nieser, *Raff. Bull. Zool.*, **52**(1) : 94.

Material examined: 4 exs., Van Vihar, 18 km. from Dholpur district, 29.ix.2002, Coll. N.S. Rathore & party.

Distribution: India: Rajasthan, Puducherry, Tamil Nadu and West Bengal. *Elsewhere* : Indonesia, Myanmar, N. Australia, New Guinea, Phillipines , Sri Lanka and S.E. Asia

Family PLEIDAE Fieber, 1851

Genus 11. ***Paraplea*** Esaki & China, 1928

24. ***Paraplea buenoi*** Kirkaldy, 1904

1904. *Plea buenoi* Kirkaldy, *Wein. Ent. Zeit.*, **28:** 128.

2005. *Paraplea buenoi* Kirkaldy : Thirumalai & Suresh Kumar, *Rec. zool. Surv. India,* **105** : 9.

Material examined: Recorded from literature (Thirumalai, 2007).

Distribution: India: Pondicherry and Rajasthan.

Family OCHTERIDAE Kirkaldy, 1906

Genus 12. *Ochterus* Latreille, 1807

25. ***Ochterus marginatus marginatus*** (Latreille, 1804)

1804. *Acanthia marginata* Laterille, *Hist. Nat. Crust. Ins. Paris,* **12** : 242.

1995. *Ochterus marginatus marginatus (*Latreille) : Polhemus et al, *Cat.Het.Palaerctic region,* **1** :23.

Material examined: 2♂♂, 1♀, Potharan, Jaisalmer, 23.iv.2015, Coll. Dr. H.S. Banyal.

Distribution: India: Assam, Bihar, Chhattisgarh, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Puducherry, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Afghanistan, Africa, Borneo, China, Europe, Iran, Japan, Korea, Malay Peninsula, Philippines, Saudi Arabia,

Taiwan, Thailand, Turkmenistan, United Arab Emirates and Vietnam.

Infraorder GERROMORPHA Popov, 1971

Family GERRIDAE Leach, 1815

Subfamily EOTRECHINAE Matsuda, 1960

Genus 13. ***Amemboa*** Esaki, 1925

26. ***Amemboa*** sp.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Genus 14. *Onychotrechus* Kirkaldy, 1903

27. ***Onychotrechus rhexenor*** Kirkaldy, 1903

1903. *Onychotrechus rhexenor* Kirkaldy, 1902. *Entomologist,* **36**: 44.

1980. *Onychotrechus rhexenor* Kirkaldy : Andersen, *Streenstrupia*, **6**(10) : 128.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2007).

Distribution: India: Chhattisgarh, Karnataka, Kerala, Maharashtra, Rajasthan and Tamil Nadu. *Elsewhere*: Socotra Island (Andersen, 1980).

Subfamily GERRINAE Bianchi, 1896

Genus 15. ***Limnogonus*** Stal, 1868

Subgenus ***Limnogonus*** Stal, 1868

28. ***Limnogonus (Limnogonus) fossarum fossarum*** (Fabricius,1775)

1775. *Cimex fossarum* Fabricius, *Syst. Ent.*, 727.

1975. *Limnogonus (Limnogonus) fossarum* (Fab.,) : Andersen, *Ent. Scand. Suppl*., **7** : 30..

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2002).

Distribution: India: Andaman and Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Uttar Pradesh, Tamil Nadu, Tripura and West Bengal. *Elsewhere:* Bangladesh, China, Hong Kong, Indonesia, Japan, Malaysia, Myanmar, Philippines, Singapore, Taiwan, Thailand and Vietnam.

29. ***Limnogonus (Limnogonus) nitidus*** (Mayr, 1865)

1865. *Hydrometra nitida* Mayr *Verh. zool. -bot. Ges. Wien*, **15**:443.

1975. *L. (Limnogonus) nitidus* Andersen. *Ent. Scand. Suppl*., **7** : 62.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2002).

Distribution: India: Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Delhi, Karnataka, Kerala, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. *Elsewhere:* China, Indonesia, Malaysia, Maldives Islands, Myanmar, Nepal, Singapore, Sri Lanka, Thailand and Vietnam.

Genus 16. ***Aquarius*** Schellenberg, 1800

30. ***Aquarius adelaides*** (Dohrn, 1860)

1860. *Aquarius adelaidis* Dohrn, *Stettin. ent. ztg*., **21**: 408.

1903. *Gerris spinolae* (Leth. and Serv.): Distant, *Fauna of British India*, **2**: 180.

2002. *Aquarius adelaidis*: Thirumalai, *Rec. zool. Surv. India*, **100** (1-2): 60.

Material examined: 1♂, 3 nymphs, Nimjad sagar, Rajsamand district, 11.ix.2013, Coll. Neena tak & party; 4 ♂♂, 3 ♀♀, Pratapgarh, Jakham river, Dholapani village, Date: 9.03.2014, Coll. Dr. H.S. Banyal; 1♀, Pratapgarh, Nagaliya dam, Dhariawad, 10.iii.2014, Coll. Dr. H.S. Banyal.

Distribution: India: Andhra Pradesh, Bihar, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere:* Australia, Bangladesh, China, Indonesia, Malacca, Myanmar, Nepal, Pakistan, Philippines, Singapore, Thailand

and West Malaysia.

Genus 17. ***Limnometra*** Mayr, 1865

31. ***Limnometra fluviorum*** (Fabricius, 1798)

1798. *Cimex fluviorum* Fabricius, *Ent. Syst. Suppl*., 543.

1995a. *Limnometra fluviorum* (Fab.) : Andersen, *Steenstrupia*, **21** : 118.

Material examined: 5♂♂, 3♀♀, Pando pole, 5km, from Sariska, Alwar district, 17.xi.1984, Coll. N.S. Rathore and party; 1 ♂, 4 ♂♂, Forest department nursery, Karauli, 22.ix.2002, Coll. Dr. N.S. Rathore and party; 1♂, 1♀, Chapli Gao-Diwar, Rajsamand District, 11.ix.2013, Coll. Neena Tak and party.

Distribution: India: Chhattisgarh, Karnataka, Kerala, Maharashtra, Puducherry, Tamil Nadu and West Bengal. *Elsewhere:* Philippines and Sri Lanka.

Family MESOVELIIDAE Douglas & Scott, 1867

Subfamily MESOVELIINAE Douglas & Scott, 1867

Genus 18. ***Mesovelia*** Mulsant & Rey, 1852

32. ***Mesovelia vittigera*** Horvath, 1895

1895. *Mesovelia vittigera* Horváth: *Revue d' Entomologie*, **14** : 160.

2007. *Mesovelia vittigera* Horváth : Thirumalai, *Rec. zool. Surv. India. Occ. Pap*., **100**(1-2) : 79.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2002).

Distribution: India: Andaman and Nicobar Islands, Arunachal Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Orissa, Pondicherry, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal. *Elsewhere:* Malaysia, Singapore, Africa, Australia, China, Egypt, Indonesia, Japan Palestine, Philippines, Syria and Sri Lanka

Family VELIIDAE Amyot & Serville, 1843

Subfamily MICROVELIINAE China & Usinger, 1949

Genus 19. ***Microvelia*** Westwood, 1834

Subgenus ***Picaultia*** Andersen and Weir, 2003

33. ***Microvelia (Picaultia) douglasi*** Scott, 1874

1874. *Microvelia douglasi* Scott, *Ann. Mag. nat. Hist.,* **14** : 448.

2003. *Microvelia (Picaultia) douglasi* Scott: Andersen and Weir, *Invert. Systematics*, **17**: 339.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2002).

Distribution: India: Andaman & Nicobar Island, Arunachal Pradesh, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal. *Elsewhere*: Australia, Indonesia, Japan, Malaysia, New Guinea, Philippines, Singapore, Sri Lanka and Taiwan.

Family HYDROMETRIDAE Billberg, 1820

Subfamily HYDROMETRINAE Esaki, 1927

Genus 20. ***Hydrometra*** Latreille, 1796

34. ***Hydrometra greeni*** Kirkaldy, 1898

1898. *Hydrometra greeni* Kirkaldy, *Entomologist,* **31**: 2.

1903a. *Hydrometra vittata* (Stal) : Distant*, Fauna British India*, **2** : 170.

1995b. *Hydrometra greeni* Kirkaldy : Polhemus & Polhemus, *Bishop. Mus. Occ. Pap*., **43**: 22.

Material examined: Recorded from literature (Thirumalai & Ramakrishna, 2002; Thirumalai, 2002).

Distribution: India: Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Puducherry, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. *Elsewhere:* Bangladesh, Cambodia, China (South), Indonesia, Japan, Malay Peninsula, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, and Vietnam (Zettel *et al*., 2017).

CONCLUSION

The current study deals with a total of 34

species belonging to 19 genera and 10 families of aquatic and semi-aquatic Hemiptera are presently known from Rajasthan. This study includes 10 new reports of water bugs to the State. This study is based on the collection made by different parties of the Zoological Survey of India.

ACKNOWLEDGEMENTS

The authors are grateful to the Director, Zoological Survey of India, and Officer in charge Hemiptera Section for providing all sorts of facilities to carry out the research work.

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Journal of Natural Resource and Development 16 (1) 19-25, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

INDUCTION OF HYPOVOLEMIA IN LARGE WHITE YORKSHIRE WEANED PIGLETS

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Received : 07.10.2020 Accepted : 11.11.2020

ABSTRACT

Pig is an important livestock species, and the only one who has been considered important as an advantageous non-rodent animal model within a large number of biomedical research areas and presently as a leading animal species within studies of xenotransplantation of animal organs into humans. Indian literature is scanty about experimental (induced) hypovolemia in laboratory animals for the study of drugs or agents in such conditions. Experimentally induced hypovolemia was attempted in 18 weaned piglets of Large White Yorkshire piglets at 75-d age. A total of 15% of estimated circulated blood volume was withdrawn from cranial vena cava, in two successive withdrawals (7.5% blood each time on day1 and day 3). Haematological values of control group piglets (six) after 3 days indicated that haemoglobin, TEC and TLC did not fluctuate significantly, whereas ESR got significantly ($P<0.05$) increased. However, from 3rd to 7th day and also from 1st to 7th day there were significant ($P<0.05$) reduction in the values of haemoglobin, ESR and TEC; being (-)12.69 and (-)16.98% for haemoglobin, (-)63.52 and (-)45.29% for ESR, (-)11.38 and (-)10.59% for TEC, respectively, indicating onset of hypovolemia. TLC did not fluctuate significantly. Such hypovolemic state in pigs could be utilized to ascertain effect of a number of drugs/ agents in improving blood picture, and their possible application in human beings.

Keywords : *Large white yorkshire piglets, induced hypovolemia.*

INTRODUCTION

Pig is cloven footed omnivorous litter-bearing nonruminant and is also said to be the most intelligent domestic animal. In India pig rearing has been very common in NE states, where they are kept as an asset for family's livelihood support. Now-a-days pig rearing is also gaining momentum in other states too. Pigsare mainly used as meat animal due to its high feed conversion ratio. However, unique products like bristles and lard are also obtained from them for specific purposes. Large White Yorkshire (LWY) is an established and recognized breed of pigs, originated in Yorkshire of northern England. This breed has gained popularity and adaptability throughout India. As per 20th All India Livestock Census (DAHDF, 2019) country possessed 9.06 million pigs. However, their number has decreased by 12.03% from the last census of 2012.

A number of laboratory animals, viz. mice, rat, hamster, guinea pig, rabbit, etc. have been used by man for long to conduct experiment before their application on human beings. Other than these

laboratory rodents, pig is recognized as an advantageous non-rodent animal model within a large number of biomedical research areas (Roth and Tuggle, 2015)and it presently is a leading animal species within studies of xenotransplantation of animal organs into humans (Schook*et al.,* 2005).

Indian literature is scanty about experimental (induced) hypovolemia in laboratory animalsfor the study of drugs or agents aiming for beneficial applications in that state. Drawing larger amount of blood from pigs is comparatively difficult comparable to other livestock as they have thick subcutaneous fat layer, which makes it difficult to locate blood vessels. Thus, present work was aimed for creating experimental hypovolemia in Large White Yorkshire (LWY) piglets in order to make the subjects ready for further experimentation.

MATERIALS AND METHODS

The experiment was conducted at Pig unit of Livestock Production Management Department of College of Veterinary and Animal Sciences, GBPUAT, Pantnagar during June 2019 to June 2020. The place is situated in Tarai plains at the foothills of Shivalik ranges of Himalayas at 29.5ºN and 79.5ºE at 243.84 m MSL, experiencing ambient temperature exceeding 42ºC in summers and below 2ºC in winters and relative humidity range of 15 to 95 per cent.

A total of 18 LWY weaned piglets of 2.5 months age, progeny of 3 sows, were available for study at the pig unit. These piglets were sexed and individually weighedat birth and at 75-d age to help them randomly divide into three groups of six (4 male and 2 female) piglets each (Table 1). The groups, I (control), II (Treatment-1) and III (treatment-2), so made had their average body weight as 8.91±3.33, 8.78±2.09 and 9.00±2.42 kg, respectively, at the time of experimental hypovolemia (Fig. 1). All the piglets were housed together in their respective groupsunder intensive system of rearing in well ventilated pens on concrete flooring and provided with similar environmental and managemental conditions.

Induced Hypovolemia: In order to attempt for induced hypovolemia, first total volume of blood in circulationin the piglet's body was estimated using the following formula(IACUC, 2007):

Estimated total blood volume in the body (ml) = animal's body weight (g) x 0.06

For induced hypovolemia 15% of the piglet's total estimated blood volume was taken out through two consecutive draws (@ 7.5% each time on day 1 and day 3), as suggested by IACUC (2007). All the 18 piglets were subjected to this protocol (Table 2).

For blood withdrawal piglets were restrained in specially designed 'V' shaped Sheesham (*Dalbergia sissoo*)wood trough (45x22cm flaps fixed with each other at 75°),which got firmly supported in the groove of the table top (Fig. 2& 3). Sufficient padding of paddy straw and gunny bags was kept in the trough as cushioning materials (Fig. 4). Piglet was placed in this trough in dorsal recumbency with head tilted downwards. Its fore and hind limbs were slightly pulled backward and apart employing 2-3 persons for proper restraining (Fig. 5).

Fig. 1 : Weighing of piglet

Fig. 2 : 'V' shaped wooden trough

Fig. 3 : Fixing of 'V' shaped wooden trough in groove of table top

Fig. 4 : 'V' shaped wooden trough with padding

Fig. 5 : Restraining of the piglet

Fig. 6 : Blood withdrawl from piglet

Cranial vena cava (pre-cava), the largest vessel was accessed from the right side of the thoracic inlet to prevent damage of vagus and recurrent laryngeal nerves which are more prominent on the left side. A needle (18 gauze, 2.5" long) fitted to 20 ml disposable syringe was advanced at 45°angle towards the left shoulder of the piglet to draw the blood as described by Swindle (2010).Specified volume of blood from each piglet was withdrawn for inducing hypovolemia (Fig.6; Table 2).

Piglets were kept under constant watch from day-1 of the experiment onwards to observe if they developed any untoward symptoms as a result of induced hypovolemia. The blood samples, obtained from control group piglets on 75th, 78th and 82nd day age, were subjected to auto haem-analyser for testing haemoglobin(g/ dl), erythrocyte sedimentation rate (ESR, mm/ hr), total erythrocyte count (TEC, x10^{6}cell/ mm^{3}) and total leucocyte count (TLC, x10^{3}cell/ mm^{3}). This helped to study reduction in the values of different haematological traits as a result of induced hypovolemia over a week period.

RESULTS AND DISCUSSION

A total of 18 LWY weaned piglets of 75-d age were subjected to experimental hypovolemia. A total of 15% of estimated circulated blood was removed in two successive attempts on day 75 and day 78 ages. The blood so removed was not discarded but was mixed (after keeping 5 ml blood as sample for study)in feed and offered to other pigs, not included in the experiment.As a special observation pig's blood was clotting very fast in the

drawing syringe itself approximately 10-15 seconds of collection.

Hypovolemia is the decrease in blood volume due to loss of blood, plasma and/ or plasma water, thereby causing decrease of intravascular contentsthat results into potential limitation of tissue perfusion.It is often seen during severe dehydration or blood loss due totrauma, surgery, adipsia or hypodipsia. If left untreated, this 'hypovolemic shock' can result in hypoxic tissue damage, organ failure, and ultimately death (Mandal, 2016).

Degree of hypovolemia was calculated using hypovolemic index (HVI) by four different methods. The first method used clinical values for setting up the input membership functions and ROC analysis for second and third methods. In the fourth method algorithm was coupled to the fuzzy rule system (Bardossy*et al*., 2011).

Guidelines for Regulating the Volume of Experimental Blood Sample Withdrawals in Laboratory Animals described the followings(SOP, 2018):

a) Circulating blood volume (CBV) should be determined from known species specific olume to weight values and not calculated based on flat percentage of body weight.
b) A maximum survival bleed not exceeding 10% of CBV is allowable once monthly.
c) Bleedings performed weekly should not exceed 7.5% of CBV.
d) Animals being bled daily may have 1% of CBV taken.
e) Exceptions to these numbers are possible with fluid replacement therapy.
f) Pig estimated CBV = 70ml/ kg

The total blood volume is reported to be @ 65 ml/ kg body weight in pigs (range 61-68 ml/ kg). A safe maximum one-time bleeding volume for survival procedures is 6.6 ml/ kg. In hemorrhagic shock models withdrawal of 37.5 ml/ kg over 60 minutes is uniformly fatal. If repeated blood samples are required then the recovery time between bleedings varies depending upon the per cent of blood that is collected. Recovery times between bleedings of various percentages of the total blood volumes are: 7.5% in 1 week, 10% in 2 weeks, 15% in 3 weeks(Swindle, 2010).

Gergely *et al*. (2011) listed several physical signs to indicate hypovolemia. These included postural vital signs such as increase in heart rate (>30/min), and decrease in systolic blood pressure decreases (>20mmHg), dry mouth and nasal mucous membranes, dry axillae and tongue, neurological signs like alterations in mental status, weakness of upper-or lower extremities.

Values of haemoglobin(g/ dl), ESR (mm/ hr), TEC ($x10^6$cell/ mm^3) and TLC ($x10^3$cell/ mm^3) of the blood samples, collected on 75^{th}, 78^{th} and 82^{nd} day age, are given in table 3. It is evident that during first 3 days the values of haemoglobin, TECand TLC did not fluctuate significantly, whereas ESR got significantly ($P<0.05$) increased, probably in order to cope-up with the reduced blood volume. Alteration in the values of Haemoglobin, ESR, TEC and TLC from 3^{rd} to 7^{th} day and from 1^{st} to 7^{th} day showed similar trend. Thesealterations being (-)12.69 and (-)16.98 % for haemoglobin, (-)63.52 and (-)45.29% for ESR, (-)11.38 and (-)10.59% for TEC, and 7.76 and 11.03% for TLC, respectively, showing significant ($P<0.05$) reduction in the values of for haemoglobin, ESR and TECduring the respective periods. Significant reduction in these values confirms induction of hypovolemia in LWY piglets (Table 3).

Values with different superscripts in the column differ significantly (a, b, c; $P< 0.05$)

The state of hypovolemia as induced experimentally in pigs is ideal to conduct a number

of studies where in the effect of a number of agents/ drugs could be evaluated for improving the blood picture and their application in human beings. The notion that is prevalent in Indian society is to consume goat milk during low blood platelets count as a result of Dengue fever, could be verified at easily. Information on such studies is scanty in literature.

Table : 1. Details of LWY piglets as experimental animals

SOW's		Piglet's				Randomly assigned group of piglets
No.	Farrowing date	Sex	No.	Body weight (kg) at		
				Birth	Start of experiment (at 75-d age)	
A	June 2, 2019	Male	1	1.75	11.50	II
		Female	2	1.99	12.10	I
		Male	3	1.60	12.00	III
		Male	4	1.74	13.10	I
		Female	5	1.41	12.30	II
		Female	6	1.54	10.50	III
B	Feb. 09, 2020	Female	7	1.15	5.95	II
		Male	8	1.29	8.20	II
		Male	9	1.37	7.85	II
		Female	10	1.37	7.30	I
		Male	11	1.23	7.60	III
		Male	12	1.36	6.40	III
		Male	13	1.15	6.10	I
C	Feb. 15, 2020	Male	14	1.43	7.50	III
		Female	15	1.79	10.00	I
		Female	16	1.42	8.68	III
		Male	17	1.47	8.20	II
		Male	18	1.13	4.90	I

Table : 2. Details of experime*ntally induced hypovolemia in LWY Piglets

Group	Piglet No.	Piglet body weight at 75-d age (kg)		Blood volume of piglet at 75-d age (ml)		Amount of blood withdrawn (ml) to create hypovolemia		
		Individual	Group	As estimated	To be withdraw to create hypovolemia	on 75 th day	on 78 th day	Total
I	2F	12.10	8.91 ± 3.33	726	108.9	55.5	55.5	111.0
	4M	13.10		786	117.9	60.0	60.0	120.0
	10F	7.30		438	65.7	34.0	34.0	68.0
	13M	6.10		366	54.9	28.0	28.0	56.0
	15F	10.00		600	90.0	45.0	45.0	90.0
	18M	4.90		294	44.1	22.5	22.5	45.0
II	3M	12.00	8.78 ± 2.09	720	108.0	55.0	55.0	110.0
	6F	10.50		630	94.5	48.0	48.0	96.0
	11M	7.60		456	68.4	35.0	35.0	70.0
	12M	6.40		384	57.6	30.0	30.0	60.0
	14M	7.50		450	67.5	35.0	35.0	70.0
	16F	8.68		520	78.0	40.0	40.0	80.0
III	1M	11.50	9.00 ± 2.42	690	103.5	53.0	53.0	106.0
	5F	12.30		738	110.7	56.5	56.5	113.0
	7F	5.95		357	53.5	27.5	27.5	55.0
	8M	8.20		492	73.8	37.5	37.5	75.0
	9M	7.85		471	70.6	36.0	36.0	72.0
	17M	8.20		492	73.8	37.5	37.5	75.0

ACKNOWLEGEMENT

Authors are thankful to Vice Chancellor, Director Experiment Station, Dean, CVASc. and Head (LPM), CVASc. of G.B.Pant University of Agriculture & Technology, Pantnagar for providing necessary facilities to conduct the experiment, as a part of MVSc. research of the first author.

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Table : 3. Haematological traits of control group hypovolemic LWY pigletsover a week

Testing on		Haemoglobin (g/ dl)	ESR (mm/ hr)	TEC ($x10^6$cell/ mm^3)	TLC ($x10^3$cell/ mm^3)
Days of age	Day of beginning of hypovolemia				
75^{th}	1^{st}	11.60^a ±0.36	7.00^a ±1.50	5.6033^a ±0.3395	16.467 ±1.642
78^{th}	3^{rd}	11.03^a ±0.16	10.50^b ±2.66	5.6533^a ±0.2939	16.967 ±1.739
82^{nd}	7^{th}	9.63^b ±0.97	3.83^c ±1.40	5.0100^b ±0.6357	18.283 ±2.113
Alteration in the values (%)					
From 1^{st} to 3^{rd} day		(-) 4.91	50.00	0.89	3.04
From 3^{rd} to 7^{th} day		(-)12.69	(-) 63.52	(-)11.38	7.76
From 1^{st} to 7^{th} day		(-)16.98	(-)45.29	(-)10.59	11.03

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Journal of Natural Resource and Development 16 (1) 26-33, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

ANALYSE THE VARIABILITY OF SOIL NUTRIENTS (PHOSPHATE, SULPHATE AND AMMONIA) IN PRAYAGRAJ CITY

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Received : 08.08.2020 Accepted : 21.09.2020

ABSTRACT

Soil plays a vital role in sustaining life on the planet. Nearly all of the vegetarian food that humans consume is grown on the Earth's soil. The soil quality plays a significant role in crop productivity i.e. soil nutrients. The growth of higher plants in many ecosystems is limited by nitrogen (or ammonia). Ammonia taken up by plants is most likely to be directly assimilated. The high concentration of ammonia can cause the toxicity. Sulphur is present in the upper horizons of most soils. Sulphur deficiency has been recognized as a limiting factor for crop production. When the concentration of sulphur increases the risk of soil acidification increases. The risks of Alzheimer's and Parkinson's diseases in acid sulphate soil are very high. Phosphorus deficient plants exhibit retarded growth, and reddish colouration. Phosphorus Maintain the normal homeostatic control of the cell. Phosphate toxicity can be caused by extensive tissue damage. The nutrients analysis is done with the help of the spectrophotometric method of soil nutrients. The concentration of sulphate found highest in the agriculture soil (203.08 - 283.93 mg/kg) and the lowest in the industrial soil (130.98 - 192.08 mg/kg), the concentration of ammonia was highest in the industrial soil sample (8.83 - 11.2 mg/kg) and lowest in the residential soil sample (6.59 - 9.3 mg/kg) and the highest concentration of phosphate was found in the residential soil sample (3.6 - 7.5 mg/kg) while the lowest concentration is found in the River basin soil sample (0.35 - 4.98 mg/kg). The present study will serve as a primary input to understand the soil pollution and monitoring the soil health of the study area.

Keywords : *Soil, soil analysis, soil nutrient, phosphate, sulphate, ammonia.*

INTRODUCTION

Soil is defined as the naturally deposited material that covers the Earth's surface and is capable of supporting plant growth and development (Parvathi and Rodrigues, 2013). Soil is the most valuable natural resource, as it is the heart of the terrestrial ecosystem. The nutrients are finite in soil and can be renewed with the help of the biogeochemical cycle. (Madhu et al. 2017). Soil is made up of non- living and living matter like- mineral particles, decaying organic matter, and microbes acting as decomposers (Sharma, 2014).

Soil plays a vital role in sustaining life on the planet. Nearly all of the vegetarian food that humans

consume is grown on Earth's soil. For agriculture, soil quality plays a significant role in crop productivity since soil nutrients and soil physical properties can directly impact yields (Pant, 2019). Vegetation plays an important role in the quality of soil formation (Shrivastava & Kanungo, 2014; Champan & Feiss, 1992). The chemical characteristics of soil vary from place to place and from time to time. This is due to variations in topography, climate, weathering processes, microbial activities, and several other biotic and abiotic factors. The nutrients, returned in the soil, exert strong feedback on the ecosystem processes (biogeochemical cycles). Plant tissues (above and below ground litter) are the main source of soil organic matter, which influences the characteristics of soil (the content of nutrients in that particular soil site). Nutrient supply varies widely among ecosystems resulting in differences in plant community structure and its production (Shrivastava & Kanungo, 2014).

Soil Sulphur exists in organic and inorganic forms. From a nutritional viewpoint, inorganic sulphate is the most important, since it is the form assimilated by plant roots. Organic sulphur is present in the upper horizons of most soils. Sulphur deficiency mainly affects light soils with high rainfall, where most sulphate will be susceptible to leaching (Eriksen, 1998). The sulphur-containing amino acids, cysteine and methionine, choline sulphate, sulpholipids, sulfonic acids, and sulfated polysaccharides have been found in soils (Freney, 1986). Sulphur deficiency has been recognized as a limiting factor for crop production. When the concentration of sulpher increases the risk of soil acidification increases. Acid sulphate soils cause extensive and serious effect on biota, including a metal imbalance in crops. The risks of Alzheimer's and Parkinson's diseases in acid sulphate soil are very high (Fältmarsh et al., 2008). The growth of higher plants in many ecosystems is limited by nitrogen (or ammonia) (Lee & Stewart, 1979). Ammonia is ubiquitous in nature, being formed from the biological degradation of proteins in soil organic matter, plant residues, and animal wastes (Freney et al., 1983). Ammonia taken up by plants is most likely to be directly assimilated and this uptake can have a strong effect on the nutrient imbalances of the plant. The high concentration of ammonia can cause the toxicity. The assimilation of ammonia by leaves releases protons which can cause cellular acidosis (Pearson & Stewart, 1993). Phosphorus plays a series of functions in plant metabolism and is one of the essential nutrients required for plant growth and development. It has functions of structural nature in macromolecules such as nucleic acids and of energy transfer in metabolic pathways of biosynthesis and degradation. Phosphate is not reduced in plants but remains in its highest oxidized form. Phosphorus deficient plants exhibit retarded growth (reduced cell and leaf expansion, respiration and photosynthesis), and often a dark green colour (higher chlorophyll concentration) and reddish colouration (Marschner, 1993). Phosphorus is an essential nutrient required for critical biological reactions that maintain the normal homeostatic control of the cell. This element is an important component of different cellular structures, including nucleic acids and cell membranes. Adequate phosphorus balance is vital for maintaining basic cellular functions, ranging from energy metabolism to cell signalling. Phosphate toxicity can be caused by extensive tissue damage (NCBI). Earlier, some research studies based on the physiological character of soil in Prayagraj city have been attained; however, past literatures doesn't provide the concentration of soil nutrients according to the land use classification.

For the study, purpose soil can be classified mainly into the following 4 types –

1. Agricultural soil
2. Residential soil
3. Industrial soil
4. River basin soil

The composition of nutrients in the above types of soil varies greatly due to the different habitats where they are found. Environmental condition also plays a significant role in the composition of the soil like seasonal variations, climates changes, rain fall etc.

MATERIALS AND METHODS

The district Prayagraj City of Uttar Pradesh lies between 24°47' and 25°N latitude and 81°9' and 82°21'E longitude. Proper collection of soil sample intended for analysis is extremely important. So, the soil samples were collected from the surface after removing the plant residues and then stored in polyethylene bags for further analyses.

Analysis of soil nutrients-

1. Phosphate-

Sediment Extract -

1 gm of air-dried sediment was taken. To it, 200 ml of 0.002 N Sulphuric acid was added. The suspension was then shaken for around 30 minutes and then filtered off using a vacuum pump -with membrane pore size being 45 micrometres.

Procedure -

25 ml of this filtered sample was taken. 1 ml ammonium molybdate and 3 drops of stannous chloride were added and the solution was left undisturbed for 10 minutes for the development of blue colour. Absorbance was then taken at 690 nm after 10 minutes, But before 15 minutes.

2. Sulphate

Sediment extraction -

1 gm of the sediment was taken into a beaker and 200 ml of 0.002 N H_2SO_4 was added to it. This suspension was shaken for about 30 minutes and then filtered off using a vacuum pump to get a clear solution. This clear solution was then used for sulphate analysis.

Procedure -

10 ml of the sample was taken 2 ml Buffer solution was added to it, followed by a pinch of $BaCl_2$.The solution was then stirred using a magnetic stirrer for 30 minutes, to allow the solution to turn turbid. Spectrophotometric readings were then taken at 420 nm.

Note - $BaCl_2$ was not added to the sample.

3. Ammonia

Sediment extraction-

5 gm of sediment was added to the 50 ml 1 N KCl solution. This solution was shaken for around 1 hour in the shaker and then filtered off using a vacuum pump.

Procedure -

25 ml sample was taken into a beaker. To it, a 1 ml phenol solution was added and the solution was allowed to react for a few minutes.1 ml Sodium nitroprusside solution followed by a 2.5 ml oxidizing solution was added to the beaker. The beaker was air sealed and kept in dark condition for about 1 hour, after which the spectrophotometric readings were taken at 640 nm.

To Find Out the Value of Soil Nutrients from the Absorbance -

Open the MS Excel sheet. Write the standard value with their respective absorbance. Click the Insert menu. Choose the scatter menu and then click on any visible point in the graph, a standard equation is found out. Fill the absorbance of a particular soil sample and click the enter button. Noted down the value and converted it into mg/kg from mg/liter.

RESULTS AND DISCUSSION

The results of soil parameters obtained in

this study are summarized in the given table-

1. Sulphate -

I. River basin soil -

Sample number	Value (in mg/kg)
1	103.6974159
2	165.4068
3	138.078798
4	173.958798
5	235.060644

II. Industrial soil-

Sample number	Value (in mg/kg)
1	150.7438101
2	130.9883718
3	160.7232939
4	192.0875268
5	170.091831

III. Residential soil -

1	178.238385
2	199.2158064
3	179.0530404
4	217.3418442
5	176.2017465

IV. Agriculture soil-

1	231.5983137
2	226.5067623
3	211.6392564
4	283.939968
5	203.0853747

2. Ammonia -

I. River basin soil-

1	9.19485996
2	10.26298065
3	9.14631432
4	9.82602504
5	9.68037018

II. Industrial soil-

1	10.74849087
2	10.26298065
3	11.20972827
4	9.26768739
5	8.830729089

III. Residential soil-

1	8.199565803
2	6.597382077
3	8.199565803
4	8.757902556
5	9.36478764

IV. Agriculture soil-

1	9.70465197
2	9.137739
3	9.82602504
4	11.50103799
5	7.835433138

3. Phosphate -

I. River basin soil-

1	4.987816041
2	1.089650484
3	2.427529572
4	1.169286144
5	0.353020629

II. Industrial soil-

1	4.418421072
2	1.762571811
3	3.856989669
4	6.357549393
5	5.565174576

III. Residential soil-

1	7.583938557
2	3.64595517
3	6.79156374
4	5.091342399
5	4.533892779

IV. Agriculture soil-

1	2.077132668
2	3.630028038
3	6.0748428
4	3.096469116
5	5.174959842

In the present study the concentration of ammonia was highest in the industrial soil sample (8.83 - 11.2 mg/kg) and lowest in the residential soil sample (6.59 - 9.3 mg/kg). Ammonia is constantly being formed in soils at rates that depend on the level of microbial activity and the susceptibility of organic nitrogen compounds to biological attack. It is also being added to soils in through the application of fertilizers. Ammonia volatilization rates that have concentrated on fertilized agricultural systems (Dawson 1977, Vlek et al., 1981). Ammonia is an irritant with a characteristic pungent odor that is widely used in industry for various purposes, giving a possibility of its high concentration in the industrial soil samples. The concentration of sulphate was highest in the agriculture soil (203.08-283.93mg/kg) and the lowest in the industrial soil (130.98 - 192.08 mg/kg). Generally, more than 95% of soil sulfur is organic bonded, and several hundred kilograms of organic suphate is present in the upper horizons of most soils. (Eriksen et al., 1998). Sulfur bears a positive correlation with organic carbon and available phosphorus (Das et al., 2018). Considerable seasonal fluctuations in the concentration of soluble sulphate in surface soils occur as a result of the interaction of seasonal conditions on the mineralization of organic sulfur, leaching, and uptake by plants. The concentration of sulphate in a point can be affected by the source of sulphur in that soil, and leaching losses (Tabatabai, 2012). Phosphorous is the second key nutrient found in the soil (Das et al., 2018). The highest concentration of phosphate was found in the residential soil sample (3.6 - 7.5 mg/kg) while the lowest concentration is found in the River basin soil sample (0.35 - 4.98 mg/kg). Microbial uptake of phosphorus and its subsequent release and redistribution plays a central role in the soil organic phosphorus cycle. Interactions with soil minerals and stabilization of organic matter and associated phosphorus in organo-mineral complexes determine the persistence and buildup of phosphorus organic through soil development, in different ecosystems, and under varying management (Stewart & Tiessen, 1987). Mineralization and immobilization of organic phosphorus compounds are relevant processes for phosphorus cycling in soils containing significant amounts of organic matter (Black, 1968; FAO, 1984). Where a water-soluble phosphorus fertilizer is applied to the soil, it reacts rapidly with the soil compounds. The resulting products are sparingly soluble phosphorus compounds and phosphorus adsorbed on soil colloidal particles (FAO, 1984). A low phosphorus concentration in the soil solution is usually adequate for normal plant growth.

CONCLUSION

The present study summarizes the variation of different soil nutrients concentrations and properties of the river basin, industrial soil, residential soil, and the agricultural soil of Prayagraj city. The assessment of soil quality of river basin, industrial, residential, and agricultural soil indicates

that sampling locations of the different soils are affected largely by anthropogenic activities. The present study reveals that the concentration of ammonia was highest in the industrial soil and lowest in the residential soil, the concentration of sulphate is high in the agriculture soil and lowest in the industrial soil, and the highest concentration of phosphate in the residential soil and lowest concentration is found in the river basin soil in the Prayagraj city. These concentrations of nutrients can vary due to the use of excess use of chemical fertilizer, use of various kinds of pesticides in agriculture, use of various kinds of chemicals which is used in the processing of several products in industries, and ultimately these can reach to the river through water and affected the quality of the river basin soil. The present study will serve as a primary input to understand the soil pollution and monitoring the soil health of the study area. Moreover, the data will be useful to the environmentalists, conservation researchers, and scientists for effective management of the soil health of Prayagraj city.

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Journal of Natural Resource and Development 16 (1) 34-38, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

HEMIPTERA: INSECTA OF TALLE WILDLIFE SANCTUARY ARUNACHAL PRADESH, INDIA WITH 10 NEW RECORDS FROM THE STATE

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Received : 07.04.2021 Accepted : 11.05.2021

ABSTRACT

The study yielded the identification of 14 species belonging 11 genera belonging to 6 families of the order Hemiptera were recorded from Talle Wildlife Sanctuary with 10 new records from Arunanchal Pradesh, India. Original and subsequent references, as well as distributional records for each of the species, are provided.

Keywords*: Hemiptera, the new record, Talle Wildlife Sanctuary, Distribution.*

INTRODUCTION

Talle Wildlife Sanctuary is located between the subansiri, Sipu, and Pange rivers surrounded by densely forested mountains in the state of Arunachal Pradesh, India.

Hemiptera is a diverse group of true bugs. Hemiptera is one of the largest groups among the hemimeabolus insects. An account of 590 species was published in Fauna of British India by Distant (1902 and 1918) from northern India, Chandra and Kushwaha 2014 recorded 17 species of Hemiptera from Tawang District of Arunanchal Pradesh and Singh *et al*. (2010) reported some bugs later on a brief account of Hemiptera of Himalayan region was given by Chandra *et al*. 2018 India

MATERIALS AND METHODS

During the survey Zoological Survey of India, the tour party had made many efforts for the exploration of faunal diversity Talle Wildlife Sanctuary. The tour party of ZSI collects about 45 bugs specimens from various localities of the WLS by handpicking, net trap, and light tarp methods, collected specimens were shorted out and bugs were pinned and dried and handed over to the identification lab for their identification, pinned bugs were identified with the help of literature available in ZSI library and Fauna of British India. The morphology of bugs was studied by Leica

microscope M205-A.

SYSTEMATIC ACCOUNT

Order Hemiptera Linnaeus, 1758

Suborder Auchenorrhyncha Linnaeus, 1758

Infraorder Cicadomorpha Evans, 1946

Superfamily Membracoidea Rafinesque, 1815

Family Aetalionidae Spinola, 1850

Tribe Darthulini Metcalf, 1939

Genus 1 *Darthula* Kirkaldy, 1900

1900. *Darthula* Kirkaldy, *The Entomologist,* **33***:* 242.

1. *Darthula hardwickii* (Gray, 1832) *

1832. *Urophora hardwickii* Gray, 1832, *Griff. Anim. Kingd., Ins.*, **2**: 261.

1900. *Darthula hardwickii* (Gray, 1832): *Kirkaldy,* 1900, *Entomologist,* **33**: 242.

1902. *Darthula hardwickii* (Gray, 1832): Distant, 1902, *Fauna Brit. India*, **4**: 78.

***Material Examined*:** 1 ex, Kelle river bed Yachul village, 27.47743°N 93.79560°E, 1161m, Lower Subansiri Dist., 10.vi.2017, R. K. Kushwaha.

Distribution: India: Assam, Meghalaya, Mizoram, Nagaland, Sikkim and West Bengal. *Elsewhere*: Africa; China; Myanmar; Nepal.

Superfamily Cicadoidea Westwood, 1840

Family Cicadidae Latreille, 1802

Subfamily Cicadinae Latreille, 1802

Tribe Dundubiini Atkinson, 1886

Subtribe Macrosemiina Kato, 1925

Genus 2 *Macrosemia* Kato, 1925

1925. *Macrosemia* Kato, *Trans. Nat. Hist. Soc. Formosa*, **15**: 57.

2. *Macrosemia saturata* (Walker, 1858)*

1850. *Dundubia obtecta* Walker, 1850 (nec Fabricius), *List. Hom. Suppl.*: 47.

1858. *Dundubia saturata* Walker, 1858, *List. Hom. Supl.*: 6.

1890. *Cosmopsaltria saturata* Distant, 1890, *Mon. Orient. Cicad*: 54.

1906. *Platylomia saturata* (Walker, 1858): Distant, 1906, *Fauna Brit. India*, **3**: 105.

2005. *Cosmopsaltria saturate* Ahmed, Siddiqui, Akhter & Rizvi, 2005, *Int. J. Biol. Biotechnol*., **2**: 845 (Misspelled).

2008. *Macrosemia saturata* Boulard, 2008, *Nouv. Rev. Entomol*., **24**: 365.

Material examined: 1 ex, At Pangge IB Talle Wildlife Sanctuary, Lower Subansiri Dist., 07.xi.2015, B. Sinha & party.

Distribution: India: Arunanchal Pradesh, Assam, Manipur, Nagaland, Sikkim, Uttarakhand and West Bengal. *Elsewhere*: Bangladesh; Bhutan; Indochina; Indonesia; Malay Peninsula; Nepal; Vietnam.

Tribe Cicadini Latreille, 1802

Subtribe Psithyristriina Distant, 1905

Genus *Pomponia* Stål, 1866

1866. *Pomponia* Stål, 1866, *Hem. Afr.*, **4**: 6.

3. *Pomponia linearis* (Walker, 1850)*

1790. *Cicada fusca* Olivier, *Enc. Meth*., 5: 749.

1866. *Pomponia linearis*: Stål: Metcalf, *General Catalogue of Homop*., **8**: 827.

***Material examined*:** 1 ex, Deed stream, Lower Subansiri Dist., 11.vi.2017, Dr. KAS.

Distribution: India: Arunanchal Pradesh**,** Assam, Manipur, Nagaland, Nilgiri Hills. Elsewhere:

Bangladesh; Indonesia; Japan; Philippines.

Tribe Talaingini Myers, 1929

SubTribe *Talaingina* Myers, 1929

Genus 3 *Talainga* Distant, 1890

1890. *Talainga* Distant, *Ann. Mag. Nat. Hist*., (6)**5**: 166.

4. *Talainga naga* Ollenbach, 1929*

1929. *Talainga naga* Ollenbach, 1929, *Indian Forest Records*, **13**: 276.

Material examined: 1 ex, Paniya stream, Tamen, 27.81791°N, 94.09502°E, Lower Subansiri Dist., 14.vi.2017, R. K. Kushwaha.

Distribution: India: Arunanchal Pradesh and Nagaland.

Superfamily Cercopoidea Leach, 1815

Family Cercopidae Leach, 1815

Subfamily Cercopinae Oshanin, 1916

Genus 4 *Cosmoscarta* Stål, 1869

1869. *Cosmoscarta* Stål, 1869, *Hem. Fabr.,* **2** : 11.

5. *Cosmoscarta decisa* (Walker, 1858)

1858. *Cercopis decisa* Walker, 1858, *List., Homop., Suppl*.: 175.

1874. *Cosmoscarta decisa*: Bulter, 1874, *Cist., Ent*., **1**: 258.

1908. *Cosmoscarta decisa*: Distant, 1908, *Fauna Brit. India*, **4**: 130.

***Material Examined*:** 1 ex, Near Raga stream, 27.80712°N, 94.0757°E, Lower Subansiri Dist., 14.vi.2017, B. Sinha & party.

Distribution: INDIA: Arunanchal Pradesh Assam, Kerala; Nagaland, Sikkim, West Bengal. *Elsewhere*: Bhutan; China; Tibet.

Infraorder:Pentatomorpha

Superfamily: Coreoidea

Family: Coreidae

Genus 5 *Ochrochira* Stal 1873

1873. *Ochrochira* Stal, *En. Hem,* **3**: 39

6. *Ochrochira granulipes* (Westwood, 1842)*

1842. *Myctis granulipes* Westwood, *in Hope Ca.,* **2**: 11.

1904. *Elasmomia granulipes* Distant, *Fauna Brit. India, Rhynchota,* **1** : 339.

1919. *Elasmomia granulipes* Paiva, *Rec. Indian Mus,* **16**: 356.

1980. *Ochrochira granulipes* : O' Shea & Schaefer, *Oriental Ins*, **14**(2): 244.

Material examined: 1 ex, Near Pangge IB at Pangge, Lower Subansiri Dist., 25.ix.2016, B. Sinha & Party.

Distribution: India: Arunachal Pradesh, Meghalaya, Sikkim, West Bengal. *Elsewhere*: China.

Genus 6 *Molipteryx Kiritshenko*, 1916

1916. *Molipteryx Kiritshenko*, Fauna Rossii. Nasekomye poluzhestkokrylye (Insecta Hemiptera) 6(2):27, 32- 42.

7. *Molipteryx hardwickii hardwickii* (White, 1839)*

1839. *Derepteryx hardwickii* White, Mag. Nat. Hist, (n.s.) 3:542:

Material Examined: 1 ex, Paro dumb, Dist: Lower Subansiri, 22.iii.2017, B. Sinha & party.

Distribution: Arunanchal Pradesh, Assam and Sikkim.

Family Pyrrhocoridae Amyot and Serville, 1843

Genus 7 *Physopelta* Amyot & Serville, 1843

8. *Physopelta gutta* (Burmeister, 1834)

1834. *Lygaeus* (Pyrrhocoris) *gutta* Burmeister, *Nova. Acta. Acad. Leop. Carolxvi*, suppl.,: 424.

2010. *Physopelta gutta* Saha and Bal, *Fauna of Uttarakhand. State Fauna Series*. 18(2):247.
Material Examined: 1 ex, Kudom bog, TWLS, Dist: Kamle dist., 06.ii.2018, B. Sinha & party.
Distribution: India: Arunachal Pradesh, Madhya Pradesh, Chhattisgarh, Maharashtra, Assam, Andhra Pradesh, Uttarakhand and West Bengal.
Elsewhere: Australia, Borneo, Myanmar, China, Japan, Java, Philippines, Sumatra and Sri Lanka.

Genus 8 *Melamphaus* Stal, 1868

1868. *Melamphaus* Stal, *Hem. Fabr.,* 1: 83

9. *Melamphaus fulvomarginatus* (Dohrn, 1860)*

1860. *Melamphaus fulvomarginatus* Dohrn, *Stet tent. Zet*. xxi, p. 405.
Material Examined: 1 ex, Paro dumb, Dist: Lower Subansiri, 22.iii.2017, B. Sinha & party.
Distribution: Arunachal Pradesh, Kerala and West Bengal. *Elsewhere*: Sri Lanka.

10. *Melamphaus faber* (Fabricius 1787)*

1787. *Melamphaus faber* Fabricius *Mant, Ins*, ii, P. 297.
Material Examined: 1 ex, Paro dumb, Dist: Lower Subansiri, 22.iii.2017, B. Sinha & party.
Distribution: Arunachal Pradesh, Assam, Nagaland, Kerala and West Bengal. *Elsewhere*: Sri Lanka and Myanamar.

Genus 9 *Dindymus* Stal, 1861

1861. *Dindymus* Stal *ofv Vet.-Akk. Forh*.

11. *Dindymus lanius* (Stål, 1863)*

1863 *Dindymus lanius* Stål Berl. Ent. Zeitschr. vii. P. 401.

Material Examined: 1 ex, La Paga village near Tarieu, Dist: Lower Subansiri, 13.vi.2017, R. K. Kushwaha.
Distribution: Arunachal Pradesh, Assam, Nagaland, Kerala and West Bengal. *Elsewhere*: Sri Lanka, China and Myanamar.

Genus 10 *Ectatops* Amyot & Serville, 1843

1843. *Ectatops* Amyot & Serville, *Hem* p. 273.

12. *Ectatops dembickyi* Stehlík, 2007

2007. *Ectatops dembickyi* StehlÌk, Largidae and Pyrrhocoroidea of Meghalaya state, India. Acta Musei Moraviae, Scientiae Biologicae 92: 115-129.
Material Examined: 5 exs, Gayung, Dist: Lower Subansiri, 19.iii.2017, B. Sinha & party.
Distribution. India: Arunachal Pradesh, Assam and Meghalaya.

13. *Ectatops indignus* (Walker, 1873)

Dindymus indignus Walker, 1873: 10 (original description). Syntype(s): Thailand: ìSiamî (BMNH). = Ectatops largoides Walker, 1873: 23 (key), 24ñ25 (original description). Syntype(s): ♂, Thailand: ìSiamî (BMNH). Synonymized with E. indignus by Distant (1902: 36). = Dindymus imitator Walker, 1873: 7 (original description). Syntype(s): Thailand: ìSiamî (BMNH). Synonymized with E. ophthalmicus by Distant (1902: 37); removed from that synonymy by Kerzhner & Voigt (2001: 78); synonymized with E. indignus by Stehlõk (2005a: 154). = Ectatops rubiaceus (not Amyot & Serville 1843): Distant (1903a): 104 (misidentification). See Kerzhner & Voigt (2001: 78). = Ectatops rubiaceus var. extensus (partim): Schmidt (1932): 241 (1 syntype ñ see Kerzhner & Voigt 2001).

Material Examined: *Material Examined*: 1 ex, Gayung, Dist: Lower Subansiri, 19.iii.2017, B. Sinha & party.
Distribution. India: Arunachal Pradesh, Assam and Meghalaya.

Superfamily : Pentatomoidea

Family Pentatomidae Leach, 1815

Genus 11 *Priassus* Stål, 1868

1868. *Priassus* Stål, *Öfv. Vet.-Ak. Förh*, 24 (1867): 518.

1951. *Mesopriassus* Kiritshenko, *True Bugs and cicads,* 190.

14. ***Priassus spiniger*** Hagl., 1868*

1868. *Priassus spiniger* Haglund, *Stett. Ent. Zeit.*, **29**: 160.

1904. *Priassus spiniger*: Distant, *Fauna Brit. India, Rhynchota*, **1**: 205.

Material Examined: 2 exs, Kudom bog, TWLS, Dist: Kamle dist, 06.ii.2018, B. Sinha & party.

Distribution: India: Arunanchal Pradesh, Jammu & Kashmir and Nagaland.

Elsewhere: Indonesia and Myanmar.

RESULTS AND DISCUSSIONS

Bugs are mainly occurs as a pest on various plants, present paper describes the 14 new records from WLS belonging to 6 families of order Hemiptera. Out of these 14 bugs, 5 species is belonging to suborder Homoptera and 9 species from suborder Heteroptera. There 10 are New Records from the Arunanchal Pradesh state, India.

Abbreviation Used: * New To Arunanchal Pradesh state, India.

ACKNOWLEDGMENT

The authors are thankful to Director Zoological Survey of India for providing necessary facilities and encouragement.

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Journal of Natural Resource and Development 16 (1) 39-42, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

MARKETING OF ROSE AND MARIGOLD FLOWERS IN PRAYAGRAJ, UTTAR PRADESH

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Received : 25.03.2021 Accepted : 21.04.2021

ABSTRACT

The study marketing of rose and marigold flowers were conducted inPrayagraj city. Primary datawere collected with help of pre- tested schedule though bench mark survey. Marketing of floriculture products is also a good source of income and employment to scores of people because harvesting processes of the crops are very drudgery prone. India being an agricultural country, where majority live in the rural areas, both men and women work very hard in the fields. The harvesting of rose comes under the severe drudgery prone activity marigold is an annual flowers plant. The harvesting of marigold flower is considered as the severe most drudgery prone activity where women labour have to keep their posture in bending position from the back facing the ground for the harvesting of flowers founds that rose and marigold are the main cash crops in Prayagraj, Uttar Pradesh, involves farmers at great number.

Keywords: *Marketing, floriculture, buds, commercial, agro-climate, entrepreneurial, drudgery, rose and marigold.*

INTRODUCTION

India has a long tradition of floriculture; appreciation of the potential of commercial floriculture has resulted in the blossoming of this field into a viable agri-business option. Availability of natural resources like diverse agro-climatic conditions permit production of a wide range of temperate and tropical flowers, almost all through the year in some part of the country or other. Improved communication facilities have increased their availability in every part of the country. The commercial activity of marketing of floriculture

products is also a good source of gainful and quality employment to scores of people (Ergonomic practices, 2003).

Farmers involved in floriculture get very high entrepreneurial opportunities but so far has found that rose and marigold are the main cash crops of Prayagraj that involves farmers at great number.

The presentstudy was taken in Prayagraj rural areas where the women are engaged in harvesting of Roses and Marigolds. These two flowers-Rose and Marigold are very drudgery prone in Prayagraj. Harvesting of these is a very drudgery prone activity for the rural women because Rose thorns make them bleed from their hands and over all body and their dress get torn. At the time of harvesting of marigold, women feel pain in their backbone,thighs, and legs; neck etc. because bending during harvesting causes pain. These are majordrudgeries of harvesting the rose and marigold for these rural women. These two flowers are planted frequently because Prayagraj is a holy and religious city where every day in all the temples people use the flowers for worship God and Godess as well as the Dhoopbatti and Agarbatti sticks also used in temple which has fragrance and these two flowers are being used especially for fragrance. Rose and marigold are cash crops in Prayagraj city.

Marigold is an annual flower plant. The harvesting of the marigold flower is considered as the severe most drudgery prone activity where women have to keep their posture in bending position from the back facing the ground for the harvesting of flowers. It leads them to severe pain in their backbone, beg, etc. to reduce such problems, the 'hybrid variety of tall plant' of marigold as well rose can help reduce or completely abandon the bending position of women while the harvesting process goes on.

MATERIALS AND METHODS

The Prayagraj city was purposively selected for the study. There are eighteen blocks off Chaka block was purposely selected and technique used as: (i)Location of the study districtPrayagraj, Block Chaka, (ii)Sampling procedure: Sample selection and size-a sample of 106 farmers, 53 from each harvesting of rose and marigold respectively was selected for the study. A village inventory and interview schedule was developed and administered with the BDO, Sabhpati and farmwomen respectively. iii. Tools for the data collection: the following tools were selected for the data collection. Interview schedule: An interview schedule were prepared to know the income of village by production of rose and marigold as well as got the information of male and female harvesters in selected area.

RESULTS AND DISCUSSION

Table -1 : incomes from flowers

Flower	Income	Percentage
Rose	10,000	71.43
Marigold	4000	28.57
Total	14,000	100

According to the table 1 of the study, I got the information that the village earns approximately every month, Rs. 10,000 by rose and 4000 by the marigold. The reason of this result is the production of rose is more than marigold.

Figure-1: Income form the flowers

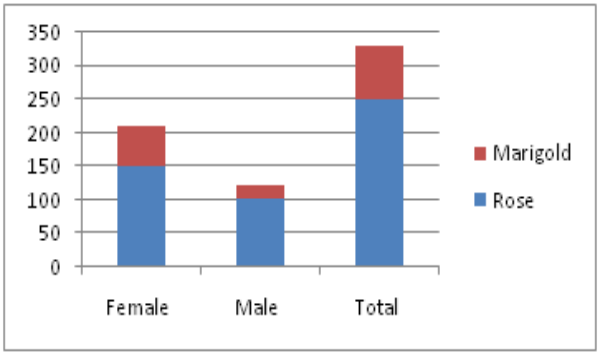
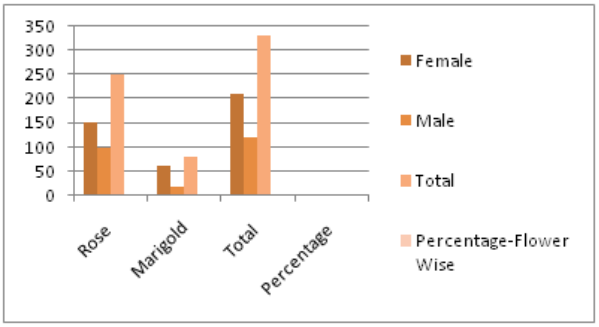


Table - 2 : Labor involved in harvesting of flowers

Labor	Rose	Marigold	Total	Percentage
Female	150	60	210	63.64%
Male	100	20	120	36.36%
Total	250	80	330	100%
Percentage-Flower Wise	75.76%	24.24%		100%

Figure-2:Labor involved in harvesting of flowers



According to the table-2 the study for rose harvesting 150 women and 100 men works and for marigold 60 women and 20 men works for marigold harvesting. Total 330 harvesters work for the flowers in which for study we select only 53 male and 53 female harvesters.

Table - 3 : Type of labor which is demanding

Type of Labor	Rose area (%)	Rose (per kg. rate)	Marigold area (%)	Marigold (per kg. rate)
Cut Flower	50%	Rs. 180	65%	Rs. 60
Buds	35%	Rs.16-20/-each	10%	Rs.50
Loose Flower	15%	Rs. 60	25%	Rs. 35

According to this table -3 of the study I got that 50% rose cut flower in market yet 65% marigold, 35% buds of roses available in market and marigold is only 10%, 15% loose rose is they sale in 180rs./kg. While 60rs./kg. of marigold and buds of rose sale in 16-20 each yet 50 Rs. /kg. In addition, loose flower in 60rs.kg. of rose in compeer of 35rs. of /kg of marigold. This data has been collected from market of Prayagraj city. In village people work for only desi breed of both flowers means they sale only buds and loose flowers, the cut flower are comes from other areas of city.

CONCLUSION

This paper has been show that rose is costly flower then marigold and 210 female harvesters are working in compare of only 120 male for both flowers but in the research area farmers use desi verities and are not able to sale cut flowers, they sale only buds and loose flowers in Prayagraj market. There is need of awareness about different hybrid verities of both flowers for farmer's better income.

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Journal of Natural Resource and Development 16 (1) 43-46, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

STUDY OF BIOCHEMICAL AND HAEMATOLOGICAL PARAMETERS TO EVALUATE TRYPANOSOME PARASITE IN COMMON INDIAN MAGUR (CLARIAS BATRACHUS)

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Received : 07.11.2020 Accepted : 11.12.2020

ABSTRACT

Trypanosomiasis is a disease caused by the infection with parasite trypanosome and this is a common infection with freshwater fishes. The main objective of the study is to evaluate biochemical and haematological parameters of trypanosome parasite in common Indian magur Clarias batrachus collected from local fish market.

Keywords : *Clarias batrachus, trypanesomiasia, biochemical.*

INTRODUCTION

Clarias batrachus(Linn.) is an air-breathing fresh waterliving and healthy specimens commonly known as "Magur" belonging to the family claridae under the siluri division of the Order, Cypriniformes (Teleost). The term Circannual is originated from the latin word circa= about, annual= year. This has been defined as an approximately 365 days Physiological pattern that regulates annual changes in activities. Circannual rhythm may also be represented in terms of seasonal rhythm (spring, summer, autumn and winter).

Trypanosomiasis is a disease caused by the infection with parasite trypanosome and this is a common infection with freshwater fishes. As reported by Haag et alin all vertebrate classesin blood and tissues of their hostsdwelling extracellularly are found in chronic infection with trypanosome [1]. Among all vertebrate classesunicellular flagellate of genus Trypanosoma are present [2].

Different morphology were observed among tryptomastigotes parasites present in fish blood. As observed by few scientist during second meal from one to another fishproboscis of leech and can be transferred with non-dividing metacyclic tryptomastigotes [3,4]. Among non-cyprinid and cyprinid freshwater fish like crucian carp, goldfis etc variety of trypanosoma infects were observed [5,6]. There were few Indian studies which brought light in the trypanosomiasis infection among fresh water fishes which are commonly found in local fish

markets [7-9].

The main objective of the study is to evaluate biochemical and haematological parameters of trypanosome parasite in common Indian magur Clarias batrachus collected from local fish market.

MATERIALS AND METHODS

From local fish market 93 freshwater magur Clarias batrachus were selected for this investigation. By using micrometryposterior end to midnucleus (PN), posterior end to kinetoplast (PK), free flagellum (F) and total length including flagellum (TL) including morphometrics distances was measured. Qualigen's Giemsa stains were used to fixed blood smears and measured at 1000x magnificationwith light microscopy to screened blood parasites. By using an autoanalyzertotal R.B.C. counts and total W.B.C. countswere determined.

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Body weight and standard length were me seared to each individual fish. by decapitating of head of the fishes for further haematological investigation blood samples were collected.

By using micrometryposterior end to midnucleus (PN), posterior end to kinetoplast (PK), free flagellum (F) and total length including flagellum (TL) including morphometrics distances was measured. Qualigen's Giemsa stains were used to fixed blood smears and measured at 1000x magnificationwith light microscopy to screened blood parasites. By using an autoanalyzertotal R.B.C. counts and total W.B.C. countswere determined.

Statistical software SPSS ver 13.0 (SPSS Inc., Chicago, IL, USA) were used to calculate statistical measurements. Values were considered statistically significant when p value < 0.05.

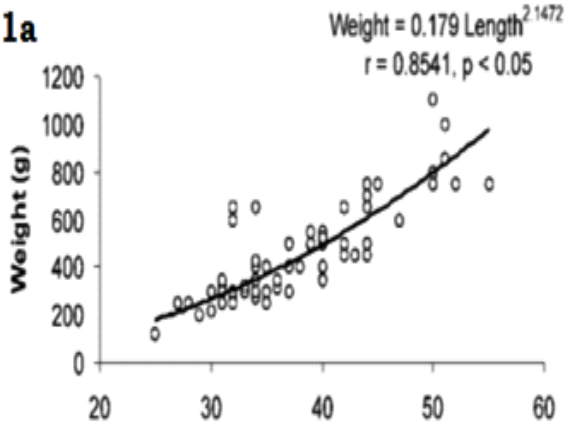
RESULTS AND DISCUSSION

It has been observed that 81.65% of Clarias batrachus were infected with parasite trypanosome. There were a drastic reduction from 95.37 Th/mm3 to 58.62 Th/mm in total WBC along with from 33.42 M/mm3 to 2.23 M/mm3 in total RBC as a consequence of this infection in Clarias batrachus. Even due to infection there were a significant decrease in small lymphocytes count. Symptoms of this infection were found to be lesions on body, at pectoral fin region swelling and sluggishness in body movements.

It has been observed that 81.65% of Clarias batrachus were infected with parasite trypanosome. Symptoms of this infection were found to be lesions on body, at pectoral fin region swelling and sluggishness in body movements. When stored at 4o C, red or white patches were appeared with change in body colour and blood samples were turned out to be appear as dark brown.

As pointed in the following figure 1a and 1b, among uninfected and infected Clarias batrachus there were no differences were found in weight length relationships.

Quality of fresh water fish like Clarias batrachuscan detoriatetrypanosome infection and can be impacted for economical losses.



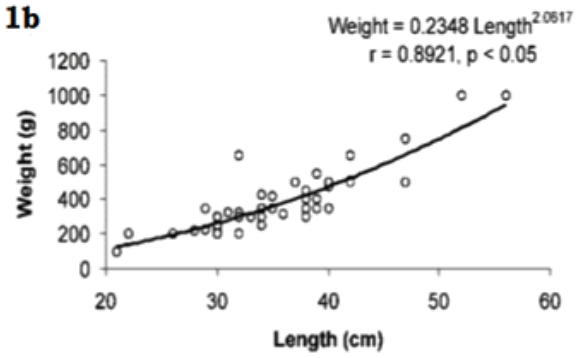


Figure :1. Infected (1a) and non-infected Clarias batrachusLength – weight relationship

There were a drastic reduction from 95.37 Th/mm3 to 58.62 Th/mm in total WBC along with from 3.42 M/mm3 to 2.23 M/mm3 in total RBC as a consequence of this infection in Clarias batrachus. Even due to infection there were a significant decrease in small lymphocytes count.

Table : 1. With trypanosomal infection parameters of infected and non-infected blood

Parameters	Infected	Non-infected	P value
RBC count	4.7234 ± 0.7097	5.4126 ±0.6471	0.4321
Total protein	0.0154 ± 0.0042	0.0231 ±0.0017	0.0132
Creatinine	0.0039 ± 0.0021	0.0021 ± 0.0010	0.0942
Albumin	0.0051 ± 0.0016)	0.0032 ±0.0021	0.4834
Urea	0.0988 ± 0.0273	0.0612 ±0.0175	0.1297
Body Muscle proteins	0.6175 ± 0.0936	0.6634 ±0.2372	0.2341

B.Rs are one of the most intriguing and exciting research field in Biology. Aquatic organisms are not exceptions; many studies have been devoted to different kinds of rhythms these organism show. Despite the immense literature on this topic, little is found regarding fishes- and even less regarding the tropical ones.In contrast with mammals, that have been intensively studied in the past (although centered on a few sps., mostly rodents), relatively few chronobiological studies have been carried out on fishes.This is especially true for teleost fishes, a most diversified group of vertibrates with more than 47000 sps. around the world, for only a few dozens have been studied in the laboratory.

As observed by by Wahul et al, from various other fishesmorphology and new speciesprevalence of trypanosomes were high [10]. As reported by Silva et. al.,variety of anemia and weight loss characterised in infected fishes as pathogenesis of disease caused by trypanosomes [11]. Due to infection of trypanosomesdecrease in weight of fish observed in present study.

As recorded in this study similar findings were also observed and reported by Suparmattaya et.al [12] lymphocyte count and by Mario Luiz de la Rue. et.al [13] in total RBC and total WBC count. Due to trypanosomiasis in Clarias batrachus, differential W.B.C's, total W.B.C's, and total R.B.C's were found. In this study it has also been observed in infected fishes there were remarkably decrease in neutrophils.

It has been observed that 81.65% of Clarias batrachus were infected with parasite trypanosome which were also inline with few earlier studies. Symptoms of this infection were found to be lesions on body, at pectoral fin region swelling and sluggishness in body movements as it can impact the economical burden. When stored at 4o C, red or white patches were appeared with change in body colour and blood samples were turned out to be appear as dark brown.

Quality of fresh water fish like Clarias batrachuscan detoriatetrypanosome infection and can be impacted for economical losses.

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Journal of Natural Resource and Development 16 (1) 47-54, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

STUDY OF PLANKTONIC DIVERSITY OF RIVER MANDAKINI , CHITRAKOOT (U.P) (QUALITATIVE AND QUANTITATIVE ANALYSIS)

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Received : 08.11.2020 Accepted : 15.12.2020

ABSTRACT

Planktons are organisms that live suspended in the water column and drift with the currents, with little or no ability to control their horizontal location having size range relatively small and microscopic or sometimes large (jellyfish), including both plants and animals which live suspended in the water column of seas, lakes, ponds and rivers and which are incapable of swimming, transporting against different physical factors such as currents, waves, wind occurring in water bodies. Examples: Diatoms, Dinoflagellates, copepods, ctenophores, lervaceans, etc. The present study was conducted to observe the status of plankton diversity, density and recovery of ecosystem after the major flash flood in the River Mandakini, Chitrakoot (U.P). Both Qualitative and Quantitative analysis of planktons were made. The study was conducted on river Mandakini at Janki Kund, Arogya dham, Chitrakoot. The Samples were collected on 2nd January 2020 for the analysis of plankton in the Mandakini river to identify and estimate the abundance of planktons. In the present study, A total of 18 phytoplankton genera belonging to five major classes, Bacillariophyceae (10 genera), Cyanophyceae (3 genera), Deinococacceae (3 genera) , Chlorophyceae (1 genera) and Gamophyceae (1 genera) were recorded from the Mandakini river. Bacillariophyceae is the most abundant group of recorded phytoplanktons .A total of 8 Zooplanktons belonging to six different orders Amphipods(2 species), Copepods(2species), Ostracod (1 species), Diptera (1 species), Cladocera (1 species), Calanoida (1 species) were recorded from Mandakini river.Amphipod and Copepods are the most abundant group of recorded zooplanktons. The overall composition of Phytoplankton was 64% with density (13.85*10^5 unit cells/ litre) and Zooplankton was 36% with density(2.595*10^5 unit cells/litre). Therefore the group of Phytoplankton was dominant in the waters of river Mandakini. This paper attempts to focus on the present planktonic status of the Mandakini river.

Keywords: *Planktons, phytoplanktons, zooplanktons, mandakini river, chitrakoot, qualitative, quantitative, analysis.*

INTRODUCTION

Chitrakoot is the 'Hill of many wonders'. It is indeed a gift of nature and gods, located in the banks of river Mandakini and falls in the northern Vindhya range spread over the states of Uttar Pradesh and Madhya Pradesh.The general topography is hilly, precipitation and undulating cut off by river Mandakini (an offshoots of Ganga) also known as Payasuni in Chitrakoot region. The River Mandakini is one of the holy rivers of India, which flows across the Chitrakoot area of the eastern part of Bundelkhand region. It is one of the major rivers of the Chitrakoot region, known as the lifeline for the people of Chitrakoot. River Mandakani originates from the hills of Khillora near Pindra village, Majhagawan block (25o 09'24.8"N, 80o 52'55.3"E), district Satna, Madhya Pradesh (M.P.) from an elevation of 156 m above the mean sea level. The catchment area of the river is 1956.3 $km^{2.}$ The basin of river Mandakani is shared by the states of Madhya Pradesh (M.P.) and Uttar Pradesh (U.P.). The perennial reach of river Mandakini is Sati Anusuiya , from where a large number of springs feed the river.

The word Plankton is originated from Greek word meaning "wanderer" or "drifter". Planktons are organisms having size range relatively small and microscopic or sometimes large (jellyfish), including both plants and animals which live suspended in the water column of seas, lakes, ponds and rivers and which are incapable of swimming, transporting against different physical factors such as currents, waves, wind occurring in water bodies. Examples: Diatoms, Dinoflagellates, coccolithophores etc. There are three functional groups of planktons, each with microbial members: Phytoplankton, Zooplankton, Saproplankton . The phytoplankton are the photoautotrophic plankton which can do photosynthesis. They are producers, or autotrophs, that forms the foundation of most marine food webs. They include microbes (cyanobacteria) and eukaryotes (algae, especially the single-celled dinoflagellates and diatoms). The zooplankton are larger heterotrophic plankton, including protozoans which play a role in aquatic food webs, as a resource for consumers on higher trophic levels (including fish). Saproplankton are those plankton found on the surface of stagnant water. These organisms inhabit water rich in decaying organic matter or in foul waters. Usually they are non-photosynthetic microorganisms. Eg: Bacteria, Fungi.

The quality of life is linked with quality of environment. The biological components of a freshwater ecosystem are ruled by the physico-chemical conditions. Phytoplankton forms the main producers of an aquatic ecosystem which control the biological productivity. The variability of phytoplankton with the seasonal changes in aquatic environment is very much necessary for the maintenance of water quality and sustainable aquaculture. The success of plankton estimation and productivity would largely depend upon the use of correct methodology which involves collections of samples, fixation, preservation, analysis and computation of data. The quality and quantity of planktons vary in relation to depth, site, time and the season of the collection. They also differ according to biological and climatic factors.Flood events directly affect the freshwater organisms (plankton, periphyton, macrophytes, macroinvertebrates, fish, etc.) inhabiting a river by displacing or killing them. They change the geomorphology of the river thus influencing freshwater ecosystems. The structure of river ecosystems determines the quality and quantity of habitat that is available to freshwater organisms. The Mandakini river was hit by major flash flood during the month of july and august 2019

which resulted into big loss to aquatic ecosystem and changed the geomorphology of the Mandakini river. Therefore, the present study was conducted to observe the status of plankton diversity, density and recovery of ecosystem after this major flash flood.

MATERIALS AND METHODS

The study was conducted on river Mandakini at Janki Kund, Arogya dham , Chitrakoot. The Samples were collected on 2nd January 2020 for the analysis of plankton diversity and density in the Mandakini river.

Plankton sampling location Janki Kund, Arogyadham, Chitrakoot

The materials required for the Qualitative and Quantitative study of planktons are: Plain slides, Cover slips, Microscope, Plankton net, Sedgewick Rafter counting cell, Water sample, Dropper, Watch glass, Petridish, 10% Formalin solution, Beaker.

There are various methods for collecting samples for plankton analysis, depending on whether a qualitative or quantitative analysis is desired. The method used in this study was "Water sampling bottles at discrete depths". In this procedure the sampling bottles or water samplers with closing mechanisms are commonly used for obtaining samples from the desired depths. Widely available plastic bottles were used to collect the water samples. This method is used mainly for collecting small forms of plankton. The water was collected at the sampling site in bottles of 2 litre capacity and was fixed in 10% formalin solution on site (it will cease the movement of planktons may finally kill them) . The bottles were sterile. The plankton were then concentrated by allowing them to settle at the bottom.

1.Qualitative Analysis of planktons: In the laboratory, the sampling bottles were well shaked and then the water was filtered with the help of plankton net into a large vessel so the large amount of species can be collected on the net. Then these species were pored in a beaker from the plankton net. Some water was poured in a petridish.Then with the help of dropper, water drop was poured on a clean slide covered with coverslip and was examined under microscope.

Picture 1: Sampling site

2. Quantitative analysis of planktons: For quantitative study of planktons, the preserved 5 litres of water sample was filtered with plankton net in a large container. The planktons were collected in the plankton net. These planktons were then poured in a beaker with little amount of water so that large quantity of planktons can be obtained. Total sample after concentration was 250ml.With the help of

dropper the water was poured over the Sedgewick Rafter's counting shell. There was no air bubble. Then the counting shell was safely placed under the mechanical stage of microscope and the planktons count was examined upto 150 shells. In Sedgewick Rafter cell, 1000 cells are present and it is used to find the density of planktons in 1ml sample. Therefore,

[n = a*100*C/ L]

Where , n=Total no.of planktons in 1 litres

a= Total no.of planktons in 1 ml

C=volume of concentrate expressed in ml

L=volume of water filtered expressed in litres

Sedgewick Rafter counting shell

RESULTS AND DISCUSSIONS

In the present study, A total of 18 phytoplankton genera belonging to five major classes, Bacillariophyceae (10 genera), Cyanophyceae (3 genera), Deinococacceae (3 genera) , Chlorophyceae (1 genera) and Gamophyceae (1 genera) were recorded_from the Mandakini river after major flash flood (Table1) and A total of 8 Zooplanktons belonging to six different orders Amphipods (2 species), Copepods (2 species), Ostracod (1 species), Diptera (1 species), Cladocera (1 species), Calanoida (1 species) were recorded from Mandakini river after major flash flood (Table 2).

Table - 1 : Phytoplanktons and their classes

Group	Genus
Bacillariophyceae	Fragilaria
	Entomonesis
	Guinardia
	Lioloma
	Leptocylindrus
	Detonula
	Lauderia
	Asterionellapsis
	Skeletonema
	Thalassiothrix
Cyanophyceae	Cylindrospermopsis
	Oscillatoria
	Planktothrix
Deinococcaceae	Ceratium
	Deinococcus
	Cochlodinium
Chlorellaceae	Chlorella
Gamophyceae	Spirogyra

Table - 2 : Zooplanktons and their classes

Order	Zooplanktons
Amphipods	Ampherusa *glacialis*
	Amphipod
Copepods	*Cyclops*
	Bradyidius *similis*
Ostracod	Boroecia *glacialis*
Diptera	*Mosquito larvae*
Cladocera	*Daphnia*
Calanoida	Gaetanus *tenuispinus*

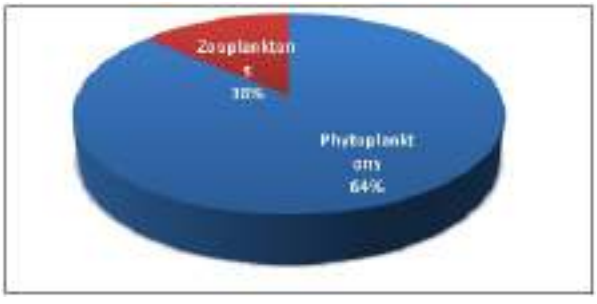
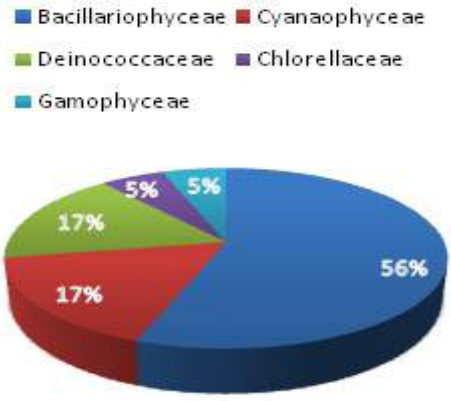
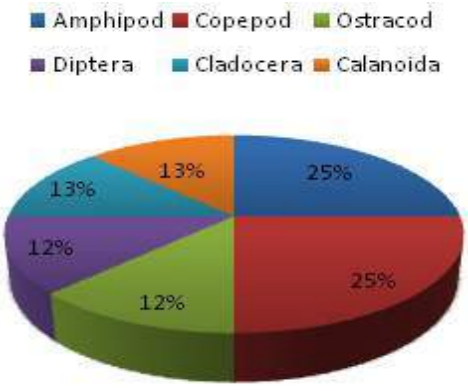


Fig.1: Pie Graph showing composition of planktons in the water of river Mandakini



Pie graph showing composition of Phytoplankton in the water of river Mandakini



Pie graph showing composition of Zooplankton in the water of river Mandakini

Phytoplanktons-:

Group- Bacillariophyceae-

Fragilaria

Fragilaria

Lauderia

Thalassiothrix

Asterionellopsis

Skeletonema

Detonula

Entomonesis

Lioloma

Group- Cyanophyceae-

Planktothrix

Cylindrospermopsis

Oscillatoria

Group- Deinococcaceae-

Ceratium

Deinococcus

Cochlodinium

Group- Chlorellaceae-

Chlorella

Group- Gamophyceae-

Spirogyra

Zooplanktons-:

Order- Amphipod-

mpherusa glacialis

Cyclops

Bradyidius similis

Group – Ostracod-

Boroecia glacialis

Group – Diptera-

Mosquito larvae

Group- Cladocera-

Daphnia

Group- Calanoida

Gaetanus tenuispinus

Qualitative status of phytoplankton community depends on river, season, water quality parameters etc. During the study period,18 genera of phytoplankton population were identified in the Mandakini river after flash flood, which falls into five major groups named Bacillariophyceae (10 genera) , Deinococcaceae (3 genera), Cyanophyceae (3 genera) , Chlorellaceae (1 genera) ,Gamophyceae (1 genera). Whereas, the qualitative status of Zooplankton recorded was very low as compared to Phytoplankton. 8 species of Zooplankton which falls under five major orders Amphipod (2 species), Copepod (2 species), Ostracod (1 species), Diptera (1 species), Cladocera (1 species), Calanoida (1 species) were identified. The composition and diversity of zooplankton provides information about the characteristics and quality of a water body. The nature of flood changes the aquatic biodiversity. Torrential flood destroys lotic habitats and leads to the decrease in biodiversity. The overall composition of Phytoplankton was 64% and Zooplankton was 36%. Therefore the group of Phytoplankton was dominant in the waters of river Mandakini. The phytoplankton population in nutrient rich waters is more diverse than those in nutrient deficient waters. Phytoplankton community directly provides food for zooplankton, macro invertebrartes and fishes of aquatic ecosystem. Flash flood can deplete phytoplankton population, however it recovers soon after some months due to their short life cycle. Phytoplankton are the primary producers, which use photosynthesis to fix CO2 into organic matter. This is a major source of organic carbon and energy, which is transferred to other trophic levels within the web. The organic compounds produced by phytoplankton can be divided into two classes, particulate or dissolved, depending on their size. Particulate organic matter (POM) compounds are large macromolecules such as polymers, which make up the structural components of the cells, including cell walls and membranes. Dissolved organic matter (DOM) is composed of smaller soluble material that passes through a filter (pore size 0.7 μm) including amino acids, carbohydrates, organic acids and nucleic acids, which are rapidly taken up by microbes and metabolized. DOM is an extremely large carbon pool, equal in size to atmospheric CO_2.

The density of phytoplankton was in the order of Bacillariophyceae (diatoms) > Cyanaophyceae (blue- green algae)> Deinococcaceae > Chlorellaceae (green algae)> Gamophyceae. A total of 10 genera of Class Bacillariophyceae were reported from the study area which included Fragilaria, Entomonesis, Guinardia, Lioloma, Leptocylindrus, Detonula, Lauderia, Asterionellapsis, Skeletonema,Thalassiothrix. Bacillariophyceae(56%) was a dominant class of phytoplankton and constituted a major component of producers in the study area and most resistant to water velocity. Cyanaophyceaea (17%) was found

less in river Mandakini. Total 3 genera was found under Cyanophyceae; Cylindrospermopsis, Oscillatoria, and Planktothrix. Similary Deinococcaceae (17%) was found less in river Mandakini. Total 3 genera was recorded under Deinococcaceae; Ceratium,Deinococcus and Cochlodinium. Chlorellaceae and Gamophyceae were found very lessin number in the Mandakini river. Their contribution was 5% and 5 % respectively. Cholrellaceae included genera Chlorella and Gamophyceae included genera Spirogyra (Table 1).

The density of Zooplankton was in the order of Amphipod > Copepod > Cladocera > Calanoida> Ostracod > Diptera >. Two species in the order Amphipod (25%) were identified; Ampherusa glacialis, Amphipod. Similarly, two species were identified in the order Copepod (25%) ; Cyclops, Bradyidius similis. In the order Calanoida (13%) one species was identified; Gaetanus tenuispinus. In the order Cladocera (13%) one species was identified; Daphnia. In the order Ostracod (12%) one species was identified; Boroecia glacialis. and in the order Diptera (12%) one species was identified; Mosquito larvae .(Table 2).

The overall collected water sample was 5 litres which was used for quantitative analysis of planktons. After concentration the total sample was 250ml. The total density of Phytoplankton was 13.85*10^5 unit cells/ litre and Zooplankton was 2.595*10^5 unit cells/litre . Hence the Phytoplankton were dominant in the river Mandakini.

CONCLUSION

Measures of diversity are frequently seen as indicators of the status of ecological systems. Present study concluded that river Manadakini have rich planktonic diversity and density. From the results, it can be concluded that Mandakini river have 10 genera of diatoms which belongs to 5 familiesof class Bacillariophyceae. On the basis of the study of the river Mandakini, Phytoplantons were more abundant than zooplanktons. Among phytoplankton, class Bacillariophyceae (56%) that includes diatoms showed the maximum abundance followed by Cyanophyceae (17%), Deinococcaceae (17%),Chlorellaceae (5%) and Gamophyceae (5%). All phytoplankton photosynthesize, but some get additional energy by consuming other organisms. Phytoplankton growth depends on the availability of carbon dioxide, sunlight, and nutrients. Phytoplankton, like land plants, require nutrients such as nitrate, phosphate, silicate, and calcium at various levels depending on the species. Some phytoplankton can fix nitrogen and can grow in areas where nitrate concentrations are low. Phytoplankton are the foundation of the aquatic food web, the primary producers, feeding everything from microscopic, animal-like zooplankton . Small fish and invertebrates also graze on the plant-like organisms, and then those smaller animals are eaten by bigger ones.

Diatoms (Bacillariophyceae) are unicellular eukaryotic microalgae that play important ecological roles on a global scale. Diatoms are responsible for 20% of global carbon fixation and 40% of marine primary productivity. Thus they are major contributors to climate change processes, and form a substantial basis of the marine food web. Another important use of diatoms in the biological realm is in water quality testing. Research by Dixit et al (1999) show that diatoms can be used for present water quality but also used to determine former water quality and trends over the years. Diatoms in the first centimeter represent the current condition of the water, while the diatoms found in deeper sediment are representative of past water quality. The high reproductive rates of

diatoms makes them respond quickly to environmental changes and many diatom species, as well, have specific tolerances for water quality. Diatoms are excellent bioindicators of both nutrients and organic matter. All the above characteristics make diatoms important as well as unique organisms. Diatoms are an important taxa not only in terms of diversity and ecology but also due to their applications in environmental monitoring, nanotechnology, biofuels, medicine, agriculture, and food industry. Their characteristic siliceous cell walls make them unique and a beautiful group to be studied. Despite their small size, they play significant ecological roles due to sheer abundance and productivity.

Cyanophyceae (blue green algae) are algal like bacteria with photosynthetic capabilities that can contaminate surface water supplies mostly during warm summer months due to the presence of a toxic component in them called microcystin. It gives the water a moldy, musty, grassy, or septic tank odor.Deinococcus radiodurans (Deinococcaceae) is an extremophilic bacterium, one of the most radiation-resistant organisms known. It shows remarkable resistance to damage caused by ionizing radiation, desiccation, UV radiation, oxidizing agents and electrophilic mutagens in the source where it is present. Chlorella(Chlorellaceae) has been considered as a good source of food and energy because its photosynthetic efficiency can reach 8%. It plays very important role in the reduction of carbon dioxide and production of oxygen where it is present.Spirogyra (Gamophyceae) also known as water silk, pond scum often indicates the nutrient enrichment of freshwater bodies. It also produces large volume of oxygen which traps as tiny bubbles between the tangling strands and causes the algae to rise.

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Journal of Natural Resource and Development 16 (1) 55-62, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

EFFECT OF PRE-HARVESTING BAGGING ON THE RIPENING AND QUALITY OF WINTER GUAVA (PSIDIUM GUAJAVA L.) FRUITS CV. L - 49

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Received : 21.08.2020 Accepted : 15.9.2020

ABSTRACT

To study the effect of pre-harvest bagging on ripening and quality of guava fruits during winter season, eleven year old prunned (P) and Unprunned (UP) trees of guava CV. L-49 were used with three replications each. The fruits were bagged with 22 X31 cm simple news paper bags on 1 January, 2008 and 2009 for both the years, when fruits were approximately at pre physiological mature stage one month prior to harvest. Bagged and non-bagged (Control) fruits were harvested at commercial mature stage. Harvested fruits were washed, disinfected and surface dried and replicated thrice. After this fruits were packed in simple brown paper bags and stored under room temperature and different storage attributes were studied. Pre-harvesting bagging of winter guava induced early maturity, ripening with full colour development and improved organoleptic rating i.e. colour, general appearance, flavour and taste of bagged fruits as compared to non bagged fruits. The bagged fruits also improved the fruit quality such as total soluble solids, ascorbic acid, total sugar and reducing sugar with low level of acidity. However, these fruits have short shelf life then non bagged fruits. Bagged fruits showed higher percent of ripening and physiological loss in weight as compared to non bagged fruits of Prunned and unprunned trees during both years of study.

Keywords : *Effect, post harvest, guvava*

INTRODUCTION

Guava, the "apple of tropics" or "poor man's apple" is a popular and common fruit belongs to the family myrtaceae (Mitra and Bose, 2001). Its chromosome number is 2n = 22(n =11) and is native to the tropical America, but it is cultivated in most of the tropical and sub-tropical countries of the world (Kennard and Winters, 1960; Samson, 1986). Guava was reported to be domesticated more than 2000 year ago (Cobley, 1976) and has been growing in West Indies since 1956 (Purseglove,1968). The plant is a hardy shrub of 3-10 M in height and is adoptable to a wide variety of habitats, in the tropics as well as in the subtropics (Verheji and Coronel, 1991).

Guava is a richest source of vitamin C (243.3 mg/100g). The whole guava is moderately good source of calcium (2.02 mg/100g), phosphorus (0.72 mg/100g), iron (0.03 mg/100g), sulphur (0.0192%), zinc (0.02mg/100g), copper (0.02 mg/100g), vitamins like thiamine (0.03-0.07mg/100g), niacin (0.20-2.32mg/100g), riboflavin (0.02-0.04mg/100g), sugar (4.9-10.1g/100g) of fruit pulp (Wilson,1980; Baralakshmi and Bhargava,1998). The guava fruits are high in pectin (Nakasone and Paull, 1998) ranging between 0.5 to 1.8% (Adsule and Kadom, 1995). Due to their astringent properties its root, bark, leaves, immature and mature guava fruits are used in local medicine for treatment of gastro-enteritis diarrhoea and dysentery (Purse Glove,1968 and Morton, 1987). Guava consumption significantly reduces serum, total cholesterol, triglycerides and the blood pressure with opposite effect in high density lipoprotein (HDL). Further, high concentration of pectin in guava fruit may play a significant role in the reduction of cholesterol and thereby decreases risk of cardio- vascular disease (Singh *et al.,* 2003).

Bagging of fruit during development can reduce disease and physical damage, and improves colour at harvest in most of the fruit (Bentley and Viveros, 1992; and Joyce *et al*., 1997). This approach is used to produce high quality; unblemished fruits in Japan (Kitagawa *et al.,* 1992) wrapping of fruits in news paper are used in several Asian countries for fruit fly control. Significant improvement in ripening and quality of winter guava fruits covered with news paper bags. It has been observed that the rejuvenation of trees could improve the yield and quality with prolonged shelf life of fruits (Singh, *et al*., 2007).

MATERIALS AND METHODS

The experiments were conducted at Horticultural Research Centre(HRC) and Post-harvest laboratory, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and technology, Meerut (U.P.), India during 2007-08 and 2008-09. Geographically, Meerut is situated between 29^0 01', North latitude and 77^0 45' East longitude at elevation of 219.75 meter above mean sea level. The total geographical area of Meerut division under western zone of U.P. is 20624 km^2.

To study the effect of pre-harvest bagging on ripening and quality of guava fruits during winter season, eleven year old prunned (P) and Unprunned (UP) trees of guava CV. L-49 were used with three replications each. The fruits were bagged with 22 X31 cm simple news paper bags on 1 January, 2008 and 2009 for both the years, when fruits were approximately at pre physiological mature stage one month prior to harvest. Bagged and non- bagged (Control) fruits were harvested at commercial mature stage. Harvested fruits were washed, disinfected and surface dried and replicated thrice. After this fruits were packed in simple brown paper bags and stored under room temperature and different storage attributes were studied.

Physiological loss in weight (PLW) was calculated by reducing the final weight from initial weight and divided by initial weight.

Total numbers of ripened fruits were counted on the basis of their appearance and desirable colour in each treatment at regular interval and the percentage was calculated.

Organoleptic rating was determined on the basis of colour, general appearance, flavour and taste of fruits by a panel of seven judges as per 'Hedonic scale' (1-9 points) as described by Amerine *et al.* (1965) and Rangana (2001).

The Total Soluble Solids (TSS) were recorded with the help of hand refrectometer. The acidity and ascorbic acid, total sugar and reducing

sugar were estimated as per method described by Ranganna (1994).

RESULTS AND DISCUSSION

1. Physical parameters

The data presented in Table -1. and Table-2. showed that the organoleptic rating i.e. fruit colour, general appearance, flavour and taste of guava during storage period with different pre-harvest treatments were effective and statistically significant. The mean score of colour decreased with increase in the storage period. The highest mean score of colour (6.30 and 6.16) during storage of bagged fruits of Prunned trees as compared to non-bagged fruits. While lowest fruit colour score (5.86 and 4.70) were observed in non-bagged fruits of Unprunned trees at 15 days of storage period during both the years of study.

The higher general appearance rating (5.96 and 6.16), highest rating of flavour (6.43 and 7.46) and maximum mean score of taste (7.10 and 7.76) were observed of bagged fruits of Prunned trees (T4) followed by bagged fruits of Unprunned trees and non-bagged fruits of Prunned trees. While, lower rating of general appearance(5.76 and 5.26), lowest rating of flavour (6.16 and 6.43) and minimum mean taste score (6.76 and 6.26) were recorded in the non-bagged fruits of Unprunned trees (T1) at 15 days after storage during both the years of investigation. This might be due to fruit skin colour was a composite expression by chlorophyll and caroteniod (Liping *et al*, 2003) and also reported that synthesis of chlorophyll, caroteniod, flavonoid were inhibited by bagging, while the total phenol, concentration in fruit skin increased, Pandey and Tondon (2004) Fruit bagging decreased the defects caused by diseases and insects and increased flesh firmness and flavour in guava fruits also reported by Kawit and Siriwan (2002).

Among various treatments, minimum physiological losses in weight (15.40 and 16.12%) were observeds in non-bagged fruits of Unprunned trees. While, maximum PLW (17.55 and 19.56%) were noted in bagged fruits of Prunned trees. Loss in weight increased with advanced in storage period and maximum physiological loss was observed on 15th days of storage during both the years of study. Similar findings suggested by Singh *et al*. (2007). However, under bagged fruits have more loss in weight, less greenness with softening of fruits and have short shelf life.Highest ripening percent (100% both the years) was recorded in bagged fruits of Prunned trees as compared to non-bagged fruits. While, lowest ripening of fruits (68.70 and 73.54%) was noted from non-bagged fruits of Unprunned trees (T_1) at 12 days after storage during both the years of investigation. This might bagged fruit may have reduced the winter stress under supro-optional condition and thereby indication of early fruit maturation (Hofman *et al*., 1995).

2. Biochemical parameters :

It is clearly indicated from the data of Table-3. and Table-4. that the TSS, acidity, ascorbic acid, total sugar and reducing sugar value of harvested guava fruit differed significantly due to treatments and storage period. Out of different treatments, the mean value of higher TSS (10.84 and 11.58 ^{o}Brix) were found from bagged fruits of prunned trees (T_4). While, the lowest mean value of TSS (9.97 and 10.03 ^{o}Brix), was recorded from non-bagged fruits of prunned trees (T_3), during the both year of study. The TSS content consistently increased due to the increase in the duration period up to 9 and 12 days of storage. Thereafter, it was decreased up to 15 days of storage. It is also observed that the TSS content of fruits increased and attained the maximum value (12.13 ^{o}Brix) at 9 days of storage with T_4 during 2008-09. This might be due to the increase in TSS may be accounted to the moisture loss, hydrolysis of

polysaccharides and conversion of organic acid into sugar. The deletion in TSS content of fruit on prolonged storage could be due to its rapid utilization during increase rate of respiration and also due to fermentation reported by Brahmchari and Rani (2005).

The acidity content of guava also varied significantly due to treatments and storage period. Among the different treatments, the maximum (0.396 and 0.399%) mean value of acidity in terms of citric acid was noted in non-bagged fruits of unprunned trees (T_1) followed by fruits of non-bagged fruits of pruned trees,T_3 (0.386 and 0.383%) and fruits of bagged fruits of pruned trees,T_2 (0.329 and 0.331%). While, the minimum acidity (0.298 and 0.282%) was recorded in full ripe bagged fruits of prunned trees during both year of study. This might be due to the depletion in acidity of guava fruits with the prolongation of storage period could be due to fast utilization of organic acids in respiration and rapid conversion of acids into salts and sugars. The similar finding suggested by Singh *et al*. (2007) in guava and Jiang *et al*. (2005) and reported that the bagging affected titratable acidity of litchi fuit at harvest with all bagged fruits having lower contents than control.

It is also observed that the ascorbic acid content decreased with advancement of storage period. The maximum (178.72 and 179.64 mg/100g) mean value of ascorbic acid was recorded in bagged fruits of pruned trees (T_4) followed by non-bagged fruits of pruned trees T_3 (154.72 and 157.27 mg/100g) and bagged fruits of unpruned trees, T_2 (144.94 and 148.35) mg/100g). Whereas, the minimum ascorbic acid content (134.50 and 138.10 mg/100g) was noted in non-bagged fruits of unpruned trees(T_1). Singh *et al*. (2007) reported that the bagged fruits have highest ascorbic acid followed by control fruits of rejuvenated trees. This might due to more availability of derivatives of sugars i.e. glucose-6-phosohates which is precursor of vitamin C (Singh *et al*. 1981).

The total sugar and reducing sugar content increased up to 6 days of storage period. Thereafter, it were decreased by increasing the storage period. The maximum mean value of total sugar (8.79 and 8.82%) and rducing sugar (5.37 and 5.15%) were recorded in bagged fruits of pruned trees (T_4) followed by bagged fruits of unpruned trees (T_2). While, minimum total sugar content 8.46 percent was recorded in non-bagged fruits of pruned trees(T_3)during the year 2007-08. But during the year 2008-09, minimum sugar content 8.58% was recorded in non-bagged fruits of unpruned trees (T_1) and minimum reducing sugar(4.63 and 4.62%) were noted in non-bagged fruits of unpruned trees (T_1) during both the year of study. Thus, the bagged fruits were effective to enhance the quantity of total sugar and reducing sugar in fruits as compared to non-bagged fruits. This might be due to the augmented rapid translocation of photosynthetes from leaves to fruits in bagged fruits. These findings supported by Pandey *et al*. (1990).

CONCLUSION

Pre-harvesting bagging of winter guava induced early maturity, ripening with full colour development and improved organoleptic rating i.e. colour, general appearance, flavour and taste of bagged fruits as compared to non bagged fruits. The bagged fruits also improved the fruit quality such as total soluble solids, ascorbic acid, total sugar and reducing sugar with low level of acidity. However, these fruits have short shelf life then non bagged fruits. Bagged fruits showed higher percent of ripening and physiological loss in weight as compared to non bagged fruits of Prunned and unprunned trees during both years of study.

Table - 1: Effect of Pre-harvest bagging on the Organoleptic rating of guava fruits from prunned and unprunned trees during storage

Treatments	Notation	Days after storage											
		3 days		6days		9days		12 days		15 days		Mean	
		2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Fruit colour													
NBUP	T_1	8.73	8.80	8.23	8.33	7.46	7.50	6.86	6.50	5.86	4.70	7.42	7.16
BUP	T_2	8.23	8.30	8.00	8.06	6.90	7.00	6.36	6.66	6.10	5.60	7.12	7.12
NBP	T_3	8.36	8.43	7.96	8.10	7.10	7.23	6.73	6.40	6.30	5.83	7.29	7.19
BP	T_4	8.208/9*6+	8.13	7.63	7.70	6.70	6.83	6.20	6.33	6.30	6.16	7.00	7.03
Mean		8.38	8.41	7.95	8.05	7.04	7.14	6.54	6.47	6.14	5.57		
C.D at 5%	2007-08	Treatment (T)= 0.253	Storage (S)= 0.283	TXS= 0.567									
	2008-09	Treatment (T)= 0.228	Storage (S)= 0.255	TXS= 0.511									
General appearance													
NBUP	T_1	7.90	7.63	6.83	6.70	6.30	6.23	6.23	6.03	5.76	5.26	6.60	6.37
BUP	T_2	8.30	8.46	7.63	7.80	7.03	6.90	6.76	6.63	5.83	5.66	7.11	7.09
NBP	T_3	8.16	8.33	7.73	7.66	6.83	6.63	6.23	6.06	5.76	5.43	6.94	6.82
BP	T_4	8.63	8.76	7.93	8.10	7.26	7.16	6.56	6.43	5.96	6.16	7.26	7.32
Mean		8.25	8.30	7.53	7.56	6.85	6.73	6.45	6.29	5.83	5.63		
C.D at 5%	2007-08	Treatment (T)= 0.303	Storage (S)= 0.339	TXS= 0.678									
	2008-09	Treatment (T)= 0.240	Storage (S)= 0.269	TXS= 0.538									
Fruits Flavour													
NBUP	T_1	5.76	5.93	6.20	6.36	7.10	7.16	7.23	7.00	6.13	6.43	6.48	6.58
BUP	T_2	6.43	6.60	6.63	6.83	7.50	7.60	6.80	7.40	6.30	7.00	6.73	7.08
NBP	T_3	5.96	6.13	6.30	6.40	7.33	7.40	6.63	7.26	6.16	6.60	6.48	6.76
BP	T_4	6.73	6.96	7.23	7.43	8.43	8.53	7.56	7.70	6.43	7.46	7.25	7.62
Mean		6.22	6.40	6.59	6.75	7.59	7.67	7.05	7.34	6.25	6.87		
C.D at 5%	2007-08	Treatment (T)= 0.280	Storage (S)= 0.313	TXS= 0.626									
	2008-09	Treatment (T)= 0.226	Storage (S)= 0.252	TXS= 0.505									

Table – 2 : Effect of Pre-harvest bagging on the Taste, Physiological loss in weight and Ripening of guava fruits from prunned and unprunned trees during storage

Treatments	Notation	Days after storage											
		3 days	6days	9days	12 days	15 days	Mean						
		2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Fruits Taste													
NBUP	T_1	5.43	5.56	6.53	6.60	7.43	7.66	8.13	7.36	6.76	6.26	6.85	6.69
BUP	T_2	6.06	6.20	7.40	7.66	8.30	8.46	7.63	7.90	6.93	7.50	7.26	7.54
NBP	T_3	5.90	6.03	6.76	6.93	7.63	7.76	7.96	7.43	6.83	6.96	7.01	7.02
BP	T_4	6.43	6.60	7.66	8.00	8.56	8.53	7.50	8.06	7.10	7.76	7.45	7.79
Mean		5.95	6.10	7.09	7.30	7.98	8.10	7.80	7.69	6.90	7.12		
C.D at 5%	2007-08	Treatment (T)= 0.239	Storage (S)= 0.268	TXS= 0.536									
	2008-09	Treatment (T)= 0.276	Storage (S)= 0.308	TXS= 0.276									
Physiological loss in weight (%)													
NBUP	T_1	2.83	2.81	6.74	6.83	10.66	10.74	14.48	14.59	15.40	16.12	10.02	10.21
BUP	T_2	3.66	3.62	8.15	8.00	12.83	12.70	16.30	16.09	17.11	18.94	11.61	11.87
NBP	T_3	4.73	4.66	7.68	7.67	11.82	11.92	15.57	15.61	16.28	18.19	11.21	11.61
BP	T_4	4.01	3.99	8.42	8.27	13.50	13.23	16.84	16.71	17.55	19.56	12.06	12.35
Mean		3.81	3.77	7.75	7.69	12.20	12.15	15.97	15.75	16.59	18.20		
C.D at 5%	2007-08	Treatment (T)= 0.389	Storage (S)= 0.436	TXS= 0.872									
	2008-09	Treatment (T)= 0.383	Storage (S)= 0.428	TXS= 0.857									
Ripening (%)													
NBUP	T_1	11.83	11.62	24.80	23.90	49.83	53.71	68.70	73.54	92.00	76.21	49.43	47.79
BUP	T_2	12.83	12.75	32.86	31.50	66.46	64.84	97.66	100.00	100.00	100.00	61.96	61.81
NBP	T_3	12.86	13.06	29.56	30.70	62.06	63.10	78.03	78.60	93.33	86.60	55.17	54.41
BP	T_4	14.06	14.00	35.63	35.66	70.60	72.07	100.00	100.00	100.00	100.00	64.06	64.34
Mean		12.90	12.86	30.71	30.44	62.24	63.43	86.10	88.03	96.33	90.70		
C.D at 5%	2007-08	Treatment (T)= 3.239	Storage (S)= 3.621	TXS= 7.243									
	2008-09	Treatment (T)= 2.883	Storage (S)= 3.223	TXS= 6.446									

Table - 3: Effect of Pre-harvest bagging on the bio-chemical parameters of guava fruits from prunned and unprunned trees during storage

Treatments	Notation	Days after storage													
		0 days		3 days		6 days		9 days		12 days		15 days		Mean	
		2007-08		2008-09		2007-08		2008-09		2007-08		2008-09			
		2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Total Soluble Solids (^{o}Brix)															
NBUP	T1	9.20	9.33	9.43	9.46	10.26	10.30	10.96	11.10	10.96	10.96	9.22	10.76	10.00	10.33
BUP	T2	10.43	10.96	10.76	11.13	10.10	11.43	11.23	11.96	11.80	11.66	10.05	11.16	10.81	11.38
NBP	T3	11.90	8.83	11.20	9.16	8.63	10.20	9.00	11.06	10.06	10.90	9.06	10.20	9.97	10.03
BP	T4	10.96	11.03	11.13	11.30	10.60	11.90	10.86	12.13	11.23	11.90	10.25	11.23	10.84	11.58
Mean		10.62	10.04	10.63	10.26	10.05	10.95	10.51	11.56	11.01	11.35	9.64	10.48		
C.D at 5%	2007-08	Treatment (T)= 0.281		Storage (S)= 0.314		TXS= 0.629									
	2008-09	Treatment (T)= 0.255		Storage (S)= 0.312		TXS= 0.625									
Acidity (%)															
NBUP	T1	0.590	0.603	0.553	0.550	0.443	0.450	0.336	0.343	0.233	0.223	0.220	0.226	0.396	0.399
BUP	T2	0.480	0.486	0.450	0.443	0.383	0.386	0.290	0.276	0.190	0.200	0.183	0.193	0.329	0.331
NBP	T3	0.560	0.570	0.520	0.543	0.456	0.446	0.326	0.313	0.236	0.220	0.223	0.206	0.386	0.383
BP	T4	0.440	0.430	0.430	0.416	0.316	0.300	0.263	0.236	0.176	0.160	0.166	0.153	0.298	0.282
Mean		0.517	0.522	0.488	0.488	0.400	0.395	0.304	0.292	0.209	0.200	0.198	0.195		
C.D at 5%	2007-08	Treatment (T)= 0.013		Storage (S)= 0.016		TXS= 0.033									
	2008-09	Treatment (T)= 0.014		Storage (S)= 0.017		TXS= 0.034									
Ascorbic acid (mg/ 100g)															
NBUP	T1	195.00	198.33	148.33	152.00	130.00	133.83	118.33	121.60	108.33	111.50	107.00	111.33	134.50	138.10
BUP	T2	201.66	203.53	173.33	176.96	140.00	145.36	123.33	126.46	116.66	120.16	114.66	117.60	144.94	148.35
NBP	T3	210.00	212.26	196.66	201.30	146.66	150.36	133.33	135.20	121.66	123.50	120.00	121.00	154.72	157.27
BP	T4	226.66	230.30	206.66	211.36	168.33	172.63	160.00	164.43	156.66	161.33	154.00	137.80	178.72	179.64
Mean		208.33	211.10	181.25	185.40	146.25	150.55	133.75	136.92	125.83	129.12	123.91	121.93		
C.D at 5%	2007-08	Treatment (T)= 6.648		Storage (S)= 8.143		TXS= 16.286									

Table – 4 : Effect of Pre-harvest bagging on the bio-chemical parameters of guava fruits from prunned and unprunned trees during storage

Treatments	Notation	Days after storage													
		0 days		3 days		6 days		9 days		12 days		15 days		Mean	
		2007-08		2008-09		2007-08		2008-09		2007-08		2008-09			
		2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Total Sugar (%)															
NBUP	T1	8.48	8.52	8.56	8.58	8.75	8.77	8.62	8.67	8.45	8.47	8.42	8.46	8.54	8.58
BUP	T2	8.55	8.58	8.72	8.64	8.80	8.85	8.69	8.88	8.57	8.54	8.53	8.53	8.64	8.67
NBP	T3	8.44	8.55	8.51	8.61	8.66	8.80	8.48	8.74	8.37	8.50	8.30	8.50	8.46	8.62
BP	T4	8.78	8.80	8.89	8.91	9.00	9.07	8.84	8.99	8.67	8.60	8.60	8.59	8.79	8.82
Mean		8.56	8.61	8.67	8.69	8.80	8.87	8.65	8.82	8.51	8.52	8.46	8.52		
C.D at 5%	2007-08	Treatment (T)= 0.041		Storage (S)= 0.050		TXS= 0.100									
	2008-09	Treatment (T)= 0.035		Storage (S)= 0.043		TXS= 0.086									
Reducing Sugar (%)															
NBUP	T1	4.67	4.70	4.72	4.75	4.80	4.86	4.75	4.78	4.65	4.42	4.21	4.27	4.63	4.63
BUP	T2	5.24	5.12	5.30	5.52	5.33	5.30	5.20	5.16	5.08	4.78	4.79	4.40	5.16	5.04
NBP	T3	4.84	4.73	4.93	4.94	5.01	5.14	4.87	4.95	4.75	4.52	4.45	4.35	4.81	4.77
BP	T4	5.45	5.50	5.59	5.36	5.58	5.38	5.44	5.26	5.25	4.89	4.91	4.54	5.37	5.15
Mean		5.05	5.01	5.13	5.14	5.18	5.17	5.06	5.04	4.93	4.65	4.59	4.39		
C.D at 5%	2007-08	Treatment (T)= 0.061		Storage (S)= 0.075		TXS= 0.151									
	2008-09	Treatment (T)= 0.149		Storage (S)= 0.182		TXS= 0.365									

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Journal of Natural Resource and Development 16 (1) 63-67, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

HEMATOLOGICAL ALTERATIONS IN BLACK RAT (RATTUS RATTUS) INDUCED BY BROMADIOLONE

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Received : 08.11.2020 Accepted : 11.12.2020

ABSTRACT

Effect of Bromadiolone on the blood picture of black rat, Rattus rattus a sublethal dose (0.12 mg/kg) body wight was studied after 24, 48 and 72 hours of treatment. The hematological changes revealed reduction in erythrocyte count, hemoglobin concentration, PCV, MCV, MCH, increase of TLC (Total leucoyte counts) in case of male and female treated rats as compared to male and female control rates. Decreasing trend in MCHC value in male and female rats after 24 and 48 hrs. were recorded. After 72 hrs. the values were slightly increased in case of females. Decrease of platelets and lymphocyte counts were recorded. Neutrophils and monocyte counts were increased. Eosinophil value of Female treated rats was found to be more than female control rats and the value of male treated rats was less than male control rats. Increase of basophil values were recorded.

Keywords : *Black rat, hematological changes, bromadialone*

INTRODUCTION

Black rats known to cause a lot of damages to human being causing distruction of property, stored food grains, standing crops and by acting as a vector for several viral, bacterial, protozous and helminthic diseases. Hence continuous search for the means and ways of rat control is required.

Helal et al (1975), studied that hematology of egyptian rodents intoxicated with anticoagulant rodenticides. Recumin 57 (Coumatetralyl). They also studied the effect of anticoagulant doses killing 50 percent and comparative observation of marifund and surviving animals. Sohalm 2 et al (1975), stated that low PCV usually accompanied low hemoglobin levels. Increased MCV and MCH values with decreased MCHC values in dogs with Taenia hydatigera were reported by Pathak and Gaur, (1983), Kumar and Agarwal have reported significant decrease in RBC, Hb, ESR and MCHC and increase in WBC count after 15 and 30 days exposure to sublethal concentration of mercuric chloride in Clarias batrachius. No attempt has been made on the hematological studies of black rat intoxicated with Bromadiolone. Therefore in the present study, attempt has been made to evaluate the hematological changes at subiethal dose against black rat Rattus rattus in the laboratory.

MATERIALS AND METHODS

The black Rats Rattus rattus were collected by trapping from houses, godowns and shops where

no rodenticide treatment had been previously carried out. Sexually matured and healthy animals were used for all tests. The rats were acclimated to the experimental laboratory for two weeks before the commencement of the experiments. Bromadiolone (Maki) supplied by M/s Pest Control (India) Pvt. Ltd., Bombay was used for the test. All the haematological studies were performed with the blood of black rat Rattus rattus.

Mature medium weight group of male and female rats were selected for the experiment. Sublethal dose calculated as 0.12 mg/kg body weight mixed in bait of active ingredients of bromadiolone were prepared for the poison bait fed to rats for only 24 hours. The rats (3 male and 3 female) were used. Equal number of animals were kept for control simultaneously. The blood picture of survivals were studied for 24, 48 and 72 hrs. of treatments. In the same time blood picture of controls were also examined. Hematological parameters such as RBC. Hb, TLC, PCV, MCV, MCH, MCHC, platelets, DLC (Lymplocytex, Neut rophil. Monocyte, Eosinophil, Basophil) were observed for 24, 48 and 72 hrs, at sublethal dose administration and are given in Table 1, 2 & 3

RESULTS AND DISCUSSION

Survivors of rats exposed to Bromadiolone at sublethal dose (Table 1, 2, 3) reveals a reduction in hemoglobin concent ration in the blood after 24, 48 and 72 hrs. of treatment in case of male and female rats. Similarly there was also a significant reduction of erythrocyte counts from 24 to 72 hrs of treatment. Regarding erythrocyte counts. the present author is of the opinion that either the homeopathic tissues might have been effected by the toxic nature produced by the anticoagulants or the cellular responces of the test must be play main role in diminished count of the erthyrocytes. Total leucocyte count (TLC) was significantly increased from 24 to 72 hrs. as compared to control male and female rats. Lynphocyte and monocyte counts shows increased pattern between control and treated groups.

The eosinophilic values slightly decrease in case of female treated groups as compared to male which increases after 24 to 72 hrs. of treatment. Basophilic blood platelets values also decreases from 24 to 72 hrs. of treatment. The blood platelets exhibited a similar trend to that of leucocytes, showing an early phase of thrombocytopenia immediately after the cessation of treatment with the anticoagulants, followed by a gradual rise to marked thrombocytosis before full recovery.

Packed cell Valune PCV shows decreasing trend from 24 to 72 hrs. between control and treated groups. PCV value decreases due do the depression of erythrocyte counts. Mean corpusculor volume (MCV) and mean corpuscular hemoglobin (MCH) shows decreasing trend from 24 to 72 hrs. of treatment between control and treated groups. Mean corpuscular haemoglobin (MCH) shows decreasing trend from 24 to 72 hrs. of treatment between control and treated groups. Mean corpuscular haemoglobin concentration (MCHC) shows decreasing trend in male and female rats of 24 and 48 hrs. except in male of 72 hrs. which shows silight increases in the value. Rats which exhibited little changes were more efficient in the recovery.

From the foregoing discussion, it might be concluded that LD_{50} dose of the toxicant (anticoagulant) which kills 50 percent of the population is more effective on the survivor rats after 24 hrs. of treatment from hematological point of view as compained with 48 to 72 hrs. of treatment further this paraodox might be explained in a way that high doses kills all susceptable animals giving chance for the tolerant ones to overcome the effect of the toxicant on the blood and to gain rapid recovery.

Table - 1: Hematological studies of black rat (Rattus-rattus) of Survivors after 24 hrs. of oral tratment with Bromadiolone at sublethal dose administration.

SI No.	Parameter	Control Rats		Treated with Bromadiolone	
		Male mean ± SE	Female mean ± SE	Male mean ± SE	Female mean ± SE
1.	RBC millons/mm^3	5.3± .91	3.8± .77	5.0± 1.02	4.0± .63
2.	Hb gm/dl	12.91± .98	10.8± 3.33	11.5± .75	9.2± .53
3.	T.L.C. cu/mm^3	3400±111.50	3200 ± 296.1	4000 ±470.32	3300 ± 179.37
4.	PCV Percent	41± 5.38	31± 2.61	37± 4.12	27.6± 3.64
5.	MCV fl	77.4± 3.92	81.5± 2.61	74.0± 3.86	69.0± 2.12
6.	MCH Pg	24.4± 9.84	28.6± 3.8	23± 4.62	23± 2.51
7.	MCHC Percent	31.5± 2.41	34.8± 3.3	31.08± 2.98	33.3± 5.1
8.	Platelets lac/cumm	1.90± .52	1.8± .52	1.65± .25	1.50± .4
9.	Lymphocyte Percent	68.4± 1.69	60.5± 2.87	62.1± 8.08	58.2± 7.27
10.	Neutrophil Percent	22.0± 2.68	26.5± 4.99	22.5± 2.41	28.6± 5.09
11.	Monocyte Percent	7.0± .63	9.0± .63	11.4± 2.62	9.5± .53
12.	Eosinophil Percent	1.70± .48	2.5± .51	2.5± .45	1.0± .25
	Basophil Percent	0.90± .36	1.5± .40	0.5± .02	1.4± .48

Table - 2 : Hematological studies of black rat (Rattus-rattus) of Survivors after 48 hrs. of oral tratment with Bromadiolone at sublethal dose administration.

SI No.	Parameter	Control Rats		Treated with Bromadiolone	
		Male mean ± SE	Female mean ± SE	Male mean ± SE	Female mean ± SE
1.	RBC millons/mm^3	5.3± .91	3.8± .77	5.1 ± 1.08	3.5± .32
2.	Hb gm/dl	12.91± .98	10.8± 3.33	12.00 ± .942	9 ± .853
3.	T.L.C. cu/mm^3	3400 ±111.50	3200 ± 296.1	4200 ±643.62	3600 ± 219.69
4.	PCV Percent	41 ± 5.38	31 ± 2.61	39 ± 1.52	27.6 ± 3.64
5.	MCV fl	77.4± 3.92	81.5 ± 2.61	76.4 ± 4.71	77.14± 1.04
6.	MCH Pg	24.4 ± 9.84	28.6± 3.8	23.5 ± 2.39	25.7 ± 3.04
7.	MCHC Percent	31.5 ± 2.41	34.8± 3.3	30.7 ± 3.02	33.3 ± 3.53
8.	Platelets lac/cumm	1.90± .52	1.8± .52	1.75 ± .27	1.48 ± .32
9.	Lymphocyte Percent	68.4 ± 1.69	60.5± 2.87	59.1± 7.72	55.7± 6.26
10.	Neutrophil Percent	22.0 ± 2.68	26.5± 4.99	29.4 ± 5.51	31.2 ± 3.15
11.	Monocyte Percent	7.0± .63	9.0± .63	9.3 ± 1.13	9.6 ± .83
12.	Eosinophil Percent	1.70± .48	2.5 ± .51	1.7 ± .27	2.2 ± .30
	Basophil Percent	0.90± .36	1.5 ± .40	0.7± .045	1.0 ± .25

Table - 3 : Hematological studies of black rat (Rattus-rattus) of Survivors after 72 hrs. of oral tratment with Bromadiolone at sublethal dose administration.

SI No.	Parameter	Control Rats		Treated with Bromadiolone	
		Male mean ± SE	Female mean ± SE	Male mean ± SE	Female mean ± SE
1.	RBC millons/mm^3	5.3 ± .91	3.8 ± .77	5.1± 1.08	3.5 ± .32
2.	Hb gm/dl	12.91± .98	10.8 ± 3.33	11.0± .69	9.6 ± .36
3.	T.L.C. cu/mm^3	3400 ±111.50	3200 ± 296.1	4400 ±644.24	3800 ± 304.14
4.	PCV Percent	41 ± 5.38	31 ± 2.61	33 ± 2.46	28 ± 3.28
5.	MCV fl	77.4 ± 3.92	81.5 ± 2.61	66 ±5.04	80 ± 1.66
6.	MCH Pg	24.4 ± 9.84	28.6 ± 3.8	21.6 ± 2.41	27.4 ± 3.14
7.	MCHC Percent	31.5 ± 2.41	34.8 ± 3.3	33.± 4.48	34 ± 3.74
8.	Platelets lac/cumm	1.90 ± .52	1.8 ± .52	1.75± .27	1.65 ± .25
9.	Lymphocyte Percent	68.4 ± 1.69	60.5 ± 2.87	51.5 ± 5.75	50.0 ± 10.8
10.	Neutrophil Percent	22.0 ± 2.68	26.5 ± 4.99	38.7± 2.49	36 ± 2.29
11.	Monocyte Percent	7.0 ± .63	9.0 ± .63	7.1± 49	9.0± .1.1
12.	Eosinophil Percent	1.70 ± .48	2.5 ± .51	1.9 ± .26	1.5 ± .28
13.	Basophil Percent	0.90 ± .36	1.5 ± .40	0.7 ± .08	0.6 ± .28

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Journal of Natural Resource and Development 16 (1) 68-78, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

CHEMICAL QUALITIES OF RAW MILK OF GOAT AND SHEEP : A COMPARATIVE STUDY

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Received : 02.08.2020 Accepted : 15.09.2020

ABSTRACT

Chemical Qualities Of Raw Milk Of Goat And Sheep -: A Comparative Study was conducted at Livestock production and management (unit), Department of NRM, Faculty of agriculture, MGCGV Chitrakoot – Satna (M.P.) during January to April 2020. The objective was to find out the comparative chemical qualities of raw milk of goat and sheep for three animal each viz. goat and sheep 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. In view of the finding and results presented above, it may be concluded that the chemical quality of milk of sheep was superior than goat milk, due to higher protein, specific gravity, fat content, lactose, total solid and solid not fat, and lower ash and water content in sheep milk.

Keywords : *Raw milk, chemical quality, goat and sheep.*

INTRODUCTION

Milk is a whitish food generally produced by the mammary secretary cells of females in a process called lactation; it is one of the defining characteristics of mammals. The milk produced by the glands is contained in the udder. Milk secreted in the first days after parturition of nutrients. Organic substances are present in about equal quantity and divided into is called colostrum *(Kebchaoui, 2012).*

Milk contains several groups elements builders, proteins, and energy components, carbohydrates and lipids. It also comprises functional elements, such as traces of vitamins, enzymes and dissolved gases, and contains dissolved salts, (O_2) *(Gautheron and Lepouze, 2012).* The goat is a hollow-horned ruminant belonging to the mammalian order artiodactyla, sub-order ruminantia, family Bovidae and either of the genera capra or hemitragus. The distinction between the two genera was first based on horn-from but in has since been confirmed genetically about distinguished characteristics. *(A Textbook of Animal*

Husbandry G.C. Banerjee Eighth Edition 2018).

It is backbone of economy of small and landless farmers in India. It is an insurance against crop failure and provides alternate source of livelihood to farmers all the year round. Goats play an important role in income generations, capital storage, employment generation and improving household nutrition. Being smaller in size they are easier to manure, require less space and can be easily handled by women and Children. *(Goat, Sheep And Pig production and management J.prasad 2014).*

Goat milk presents a rich and complex autochthonous microbiota, and its detailed knowledge is essential for the diversification of productions. This microbiota is responsible for the peculiar characteristics presented by fermented goat milk products and is composed by a wide range of micro-organisms with different characteristics that can be potentially considered for use by the dairy industry. According to previous surveys, the main components of the autochthonous microbiota are lactic acid bacteria (LAB) belonging to the genera Lactococcus, Lactobacillus, Enterococcus, Leuconostoc, and Streptococcus. (*A. Badis, D. Guetarni, B. Moussa-Boudjemaa, D. E. Henni, M. E. Tornadijo, and M. Kihal 2004 A. Picon, S. Garde, M. Avila, and M. Nu nez 2016)*.

Sheep *(ovisaries)* is most docile and earliest domesticated among farm animals for basic needs of food and Clothings. It converts food and roughage cheaply into good cash products and fertilize land. Sheep are small animals easy to manage. They are kept by poor farmers and landless labourers for meat, wool, skin, manure, and to extent even milk. Sheep with multifaceted utility plays an important role in arid and semi-arid areas with marginal and Sub-marginal land unfit for crop production, even under dry land farming. *(Goat, Sheep and Pig production and management J. prasad 2014).*

Sheep milk is an excellent raw material for the milk processing industry especially in cheese production *(Park et al., 2007).*

MATERIALS AND METHODS

Duration and Place of Study

The period of experiment was one month (January- April, 2020). Milk was collected at the Mini Dairy Farm Rajola 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 Sample

The objective was to find out the comparative chemical qualities of raw milk of goat and sheep for three animal each viz. goat and sheep 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.

Distribution of Goat and Sheep

Goat no.: 70,80,90

Sheep no.: 111,112,113

Goat			Sheep		
G_1	G_2	G_3	S_4	S_5	S_6
70	80	90	111	112	113

Determination of Protein

Add to the clean and dry Kjeldahl flask, 5-10 boiling aids, 15g K_2SO_4, 1.0ml of the copper sulphate solution, approximately 5±0.1 g of prepared milk sample (or milk product sample

containing equipment amount of protein), weighed to the nearest 0.1mg, and add 25ml of concentrated sulphuric acid. Use the 25ml acid also to wash down any copper sulphate solution, K_2SO_4 or milk left on the neck of the flask. Gently mix the contents of the Kjeldahl flask. Titrate the boric acid receiving solution with standard hydrochloric acid solution (0.1 N) to the first trace of pink colour. Take the burette reading to at least the nearest 0.05ml. A lighted stir plate plate may aid visualization of the end point.

Calculate the nitrogen content, expressed as a percentage by mass, by following formula-

$$Wn = \frac{1.4007 \times (Vs-Vb) \times N}{W}$$

Wn = nitrogen content of sample, expressed as a percentage by mass;

VS = Volume in ml of the standard hydrochloric acid used for sample;

VB = Volume in ml of the standard hydrochloric acid used for blank test;

N = Normality of the standard hydrochloric acid expressed to four decimal places;

W = mass of test portion in g, expressed to nearest 0.1 mg.

Specific Gravity

The specific gravity of milk were determined by lactometer.

Determination of Fat

The milk is mixed with sulphuric acid and iso-amyl alcohol in a special Gerber tube, permitting dissolution of the protein and release of fat. The tubes are centrifuged and the fat rising into the calibrated part of the tube is measured as a percentage of the fat content of the milk sample. The method is suitable as a routine or screening test. It is an empirical method and reproducible results can be obtained if procedure is followed correctly.

Measure 10 ml of sulphuric acid into a butyrometer tube, preferably by use of an automatic dispenser, without wetting the neck of the tube. Mix the milk sample gently but thoroughly and fill the milk pipette above the graduation line. Wipe the outside of the pipette and allow the milk level to fall so that the top of meniscus is level with the mark. Run the milk into the butyrometer tube along the side wall without wetting the neck, leave to drain for three seconds and touch the pipette's tip once against the base of the neck of the butyrometer tube. Add 1 ml of Amyl alcohol, close with a lock stopper, shake until homogeneous, inverting it for complete admixture of the acid. Keep in a water bath for 5 min. at 65±2 ^{0}C taking care to have casein particles if any to dissolve fully, and centrifuge for 4 min. at 1100 rpm. The tubes should be put in centrifuge, so as to conform to radial symmetry, and as evenly spaced as possible, in order to protect bearings of the centrifuge. Allow the centrifuge to come to rest. Remove the butyrometer tubes and place in water bath for 5 min. at 65±2 ^{0}C. Read the percentage of fat after adjusting the height in the tube as necessary by movements of the lock stopper with the key. Note the scale reading corresponding to the lowest point of the fat meniscus and the surface of separation of the fat and acid. When readings are being taken hold the butyrometer with the graduated portion vertical, keep the point being read in level with the eye, and then read the butyrometer to the nearest half of the smallest scale division.

Determination of Lactose

Pipette 5 ml each of working standard lactose and unknown solution into 25 ml test tubes. Add 5 ml of glycine NaOH buffer, 0.5 ml of methylamine solution and 0.5 ml of sodium sulphite solution in each tube, mix thoroughly. Heat tubes in a thermostatically controlled water bath at 65 ^{0}C for 25 min. and cool immediately in an ice water bath

for 2 min. to stop the reaction. Read absorbance against blank at 540 nm in a spectrophotometer or a suitable spectrophotometer. Draw a standard curve by plotting absorbance against concentration of lactose and determine the concentration of lactose from it.

Determination of Ash

Weigh accurately about 3 g of the dried milk sample in the crucible, previously dried in a hot air oven and weighed. Heat the crucible gently on a burner or hot plate at 20 ^{0}C till grey ash is obtained. cool±first and then strongly in a muffle furnace at 550 20^{0}C for 30±the crucible in a desiccators and weigh. Repeat this process again at 550 min. Cool the crucible in a desiccators and weigh. Repeat this process of heating for 30 min, cooling and weighing until the difference between two successive weighing is less than 1 mg. Record the lowest mass.

$$\text{Total Ash} = \frac{(M_2 - M)}{(100-Mo) \times (M_1-M)}$$

Where,

M2 = mass in g, of the crucible with ash;

M = mass in g, of the empty crucible;

M1 = mass in g, of the crucible with the material taken for the test; and

M0 = moisture, % by mass, calculated as per the method for dried milk.

Determination of total solid

Heat a dish containing about 20g of the sand with its lid alongside and a stirring rod on top of the lid, in a hot air oven at 102 ± 2 ^{0}C for about 1 h. B. Place the lid (with the stirring rod on the top) on the dish, immediately transfer the dish to the desiccator, allow to cool for at least 45 min, and weigh the dish with lid and rod to the nearest 0.1mg. Tilt the sand to one side of the prepared dish, place on the clear space 2.0 g of the prepared test sample of condensed milk, replace the lid with the stirring rod on top and weigh the dish to the nearest 0.1 mg. Add 5 ml of distilled water to the test portion in the dish and mix with the stirring rod. Thoroughly mix together the diluted test portion and the sand, and spread the mixture evenly over the bottom of the dish. Leave the stirring end of the rod in the mixture with the other end resting on the rim of the dish. Heat the dish on a boiling water-bath, with as much as possible of the bottom of the dish exposed to steam, for approximately 30 min stirring the mixture frequently in the early stages of drying so that the mixture is well aerated and becomes crumbly. Lay the stirring rod flat inside the dish, dry the bottom of the dish and heat the dish, with its lid alongside, in a hot air over maintained at 102 ± 2 ^{0}C for 4 h. Place the lid on the dish, allow the dish to cool in the desiccators and weigh to the nearest 0.1mg. Repeat the above operations described above (heating the dish for 1 h) until the difference in mass between two successive weighing does not exceed 0.5mg. Record the lowest mass-

$$\text{Total Solids \% by mass} = \frac{(M_2 - M)}{(M_1 - M)} \times 100$$

Where,

M = mass in g, of the dish, lid and stirring rod;

M1 = mass in g, of the dish, lid, stirring rod and test portion; and

M2 = in g, of the dish, lid, stirring rod and dried test portion.

Determination of water:-

Water percent

Water percent = 100-T.S.

Where,

T.S. = Total Solids

Determination Solid Not Fat

Pipette 10 ml of reconstituted milk into each porcelain dish. To one dish, add 1 ml of working

solution of rosaniline acetate or cobalt sulphate solution and stir with a glass rod. This solution will be external end point references. To the other porcelain dish add 1 ml of phenolphthalein solution and titrate with 0.1 N sodium hydroxide, stirring to mix the sample. Continue titration until the colour is comparable to the reference solution.

Determine solid not fat in the sample by deducting moisture and milk fat and calculate acidity in terms of ml of 0.1N NaOH / 10g Milk solids not Fat as per requirement of FSSAI Rule as shown below:

$$\frac{\text{volume of 0.1 NaOH} \times 100 \times 100 \times 10}{\text{Weight of MSNF} \times \text{Weight of sample}}$$

RESULTS AND DISCUSSION

(1) Protein (%)

Table 1.0 and Fig. 1.0 furnish the data on protein percentage in raw milk of Goat and Sheep. The results obtained showed that Goat and Sheep registered mean protein percentage as 4.45, 4.50, 4.59 (overall 4.51) and 4.58, 4.63, 4.71 (overall 4.64), respectively. The difference in the values due to animals was significant. Due to replication, the difference was non-significant .The Protein percentage was higher in Sheep milk in comparison to Goat milk.

Table - 1.0 : Protein (%) in Goat and Sheep milk

Sl. No.	Replication	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	4.40	4.50	4.55	**4.48**	4.50	4.65	4.65	**4.60**
2	R_2	4.50	4.50	4.60	**4.53**	4.60	4.60	4.70	**4.63**
3	R_3	4.50	4.50	4.60	**4.53**	4.70	4.60	4.70	**4.67**
4	R_4	4.40	4.50	4.55	**4.48**	4.55	4.65	4.70	**4.63**
5	R_5	4.40	4.50	4.55	**4.48**	4.55	4.65	4.60	**4.60**
6	R_6	4.45	4.50	4.55	**4.50**	4.55	4.65	4.70	**4.63**
7	R_7	4.45	4.50	4.50	**4.48**	4.55	4.60	4.70	**4.62**
8	R_8	4.45	4.50	4.65	**4.53**	4.60	4.65	4.80	**4.68**
9	R_9	4.40	4.50	4.70	**4.53**	4.55	4.65	4.80	**4.67**
10	R_{10}	4.50	4.50	4.60	**4.53**	4.60	4.60	4.72	**4.64**
Range	Minimum	4.40	4.50	4.50		4.50	4.60	4.60	
	Maximum	4.50	4.50	4.70		4.70	4.65	4.80	
	Mean	**4.45**	**4.50**	**4.59**	**4.51**	**4.58**	**4.63**	**4.71**	**4.64**
F- test					S				S
S. Ed. (±)					0.03				0.04
C. D. (P = 0.05)					0.07				0.08

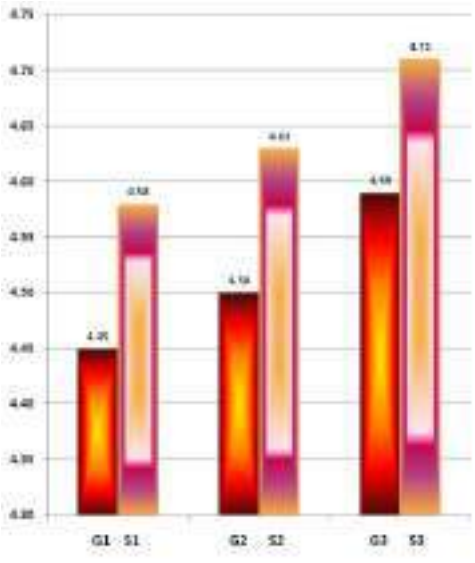

Fig. 1.0- Protein (%) in Goat and Sheep milk

(2) Specific gravity (%)

Table 2.0 and Fig. 2.0 contain the data on specific gravity (cc) of raw milk of Goat and Sheep. The results obtained showed that Goat and Sheep registered mean specific gravity as 1.009, 1.014, 1.010 (overall 1.011), and 1.059, 1.051, 1.048 (overall 1.053), respectively. The difference in the values due to animals as well as due to replication was non-significant in Goat and Sheep milk. Specific gravity of Sheep milk was greater than Goat milk.

Table - 2.0 : Specific gravity (cc) of Goat and Sheep milk

Sl. No.	Replica-tion	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	1.017	1.012	1.008	**1.012**	1.066	1.066	1.030	**1.054**
2	R_2	0.995	1.014	1.010	**1.006**	1.060	1.030	1.060	**1.050**
3	R_3	1.010	1.025	1.008	**1.014**	1.058	1.066	1.055	**1.060**
4	R_4	1.010	1.005	1.020	**1.012**	1.062	1.038	1.060	**1.053**
5	R_5	1.017	1.016	1.000	**1.011**	1.040	1.048	1.055	**1.048**
6	R_6	0.995	1.012	1.018	**1.008**	1.065	1.035	1.055	**1.052**
7	R_7	1.030	1.013	1.010	**1.018**	1.060	1.070	1.040	**1.057**
8	R_8	1.000	1.020	1.010	**1.010**	1.065	1.040	1.045	**1.050**
9	R_9	1.010	1.005	1.007	**1.007**	1.058	1.056	1.048	**1.054**
10	R_{10}	1.005	1.015	1.010	**1.010**	1.055	1.058	1.035	**1.049**
Range	Minimum	0.995	1.005	1.000		1.040	1.030	1.030	
	Maximum	1.030	1.025	1.020		1.066	1.070	1.060	
	Mean	**1.009**	**1.014**	**1.010**	**1.011**	**1.059**	**1.051**	**1.048**	**1.053**
F- test					NS				NS
S. Ed. (±)					-				-
C. D. (P = 0.05)					-				-

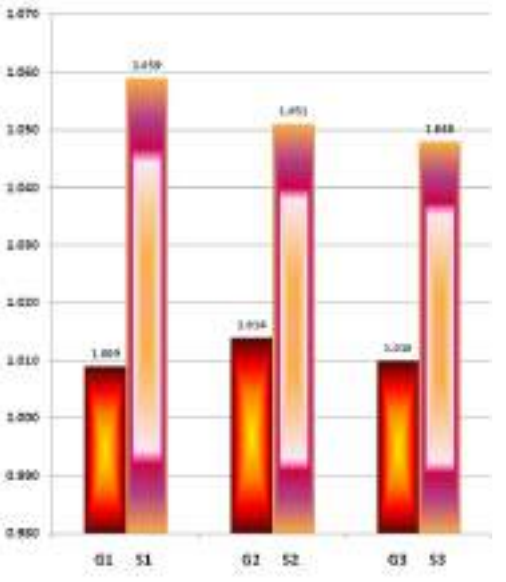

Fig. 2.0- Specific gravity (cc) of Goat and Sheep milk

(3) Fat (%)

The data on fat percentage in raw milk of Goat and Sheep is furnished in Table 3.0 and Fig. 3.0. The results contained in the Table showed that Goat and Sheep registered mean fat percentage as 3.75, 3.86, 3.82 (overall 3.81) and 8.61, 8.54, 8.60 (overall 8.58), respectively. The differences in these values due to three animals was found significant, but due to replication, the differences were non-significant in both, Goat and Sheep milk.

Table - 3.0 : Fat (%) in Goat and Sheep milk

Sl. No.	Replica-tion	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	3.74	3.85	3.80	**3.80**	8.55	8.50	8.60	**8.55**
2	R_2	3.75	3.90	3.85	**3.83**	8.60	8.55	8.55	**8.57**
3	R_3	3.80	3.85	3.80	**3.82**	8.65	8.55	8.55	**8.58**
4	R_4	3.80	3.85	3.80	**3.82**	8.60	8.50	8.60	**8.57**
5	R_5	3.75	3.80	3.75	**3.77**	8.65	8.55	8.60	**8.60**
6	R_6	3.75	3.85	3.90	**3.83**	8.65	8.60	8.65	**8.63**
7	R_7	3.75	3.90	3.85	**3.83**	8.60	8.55	8.65	**8.60**
8	R_8	3.75	3.85	3.80	**3.80**	8.65	8.55	8.60	**8.60**
9	R_9	3.70	3.90	3.85	**3.82**	8.50	8.55	8.55	**8.53**
10	R_{10}	3.75	3.85	3.75	**3.78**	8.60	8.50	8.60	**8.57**
Range	Minimum	3.70	3.80	3.75		8.50	8.50	8.55	
	Maximum	3.80	3.90	3.90		8.65	8.60	8.65	
	Mean	**3.75**	**3.86**	**3.82**	**3.81**	**8.61**	**8.54**	**8.60**	**8.58**
F- test					S				S
S. Ed. (±)					0.03				0.03
C. D. (P = 0.05)					0.06				0.06

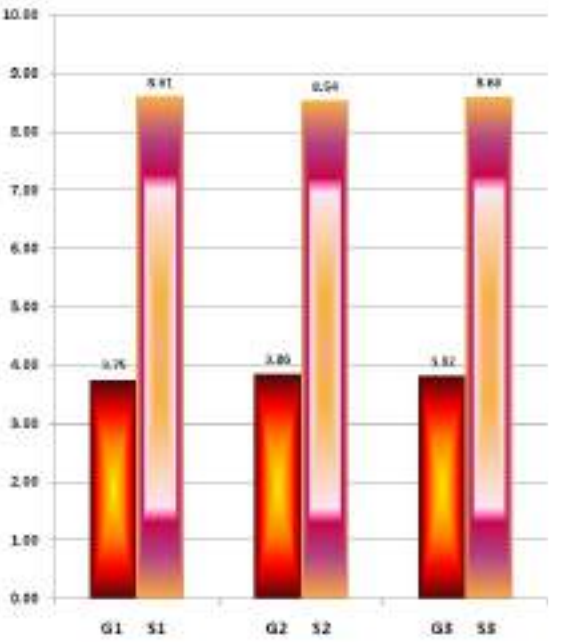

Fig. 3.0- Fat (%) in Goat and Sheep milk

(4) Lactose (%)

Table 4.0 and Fig. 4.0 presents the data on lactose percentage in raw milk of Goat and Sheep. The results contained in the Table showed that Goat and Sheep registered mean lactose percentage as 4.55, 4.49, 4.47 (overall 4.50) and 4.94, 4.92, 4.87 (overall 4.91), respectively. The difference in these values due to animals as well as due to replication were significant. Higher lactose content was found in Sheep milk.

Table - 4.0 : Lactose (%) in Goat and Sheep milk

Sl. No.	Replication	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	4.40	4.40	4.35	**4.38**	4.90	4.85	4.85	**4.87**
2	R_2	4.55	4.50	4.50	**4.52**	5.00	5.00	4.85	**4.95**
3	R_3	4.55	4.40	4.40	**4.45**	5.00	4.95	4.85	**4.93**
4	R_4	4.65	4.55	4.60	**4.60**	4.95	4.95	4.90	**4.93**
5	R_5	4.50	4.50	4.45	**4.48**	5.00	5.00	4.95	**4.98**
6	R_6	4.60	4.55	4.50	**4.55**	4.95	4.95	4.90	**4.93**
7	R_7	4.65	4.60	4.60	**4.62**	5.00	5.00	4.95	**4.98**
8	R_8	4.45	4.40	4.35	**4.40**	4.80	4.80	4.75	**4.78**
9	R_9	4.60	4.50	4.45	**4.52**	4.95	4.90	4.90	**4.92**
10	R_{10}	4.55	4.45	4.45	**4.48**	4.80	4.80	4.75	**4.78**
Range	Minimum	4.40	4.40	4.35		4.80	4.80	4.75	
	Maximum	4.65	4.60	4.60		5.00	5.00	4.95	
	Mean	**4.55**	**4.49**	**4.47**	**4.50**	**4.94**	**4.92**	**4.87**	**4.91**
F- test					S				S
S. Ed. (±)					0.02				0.02
C. D. (P = 0.05)					0.05				0.25

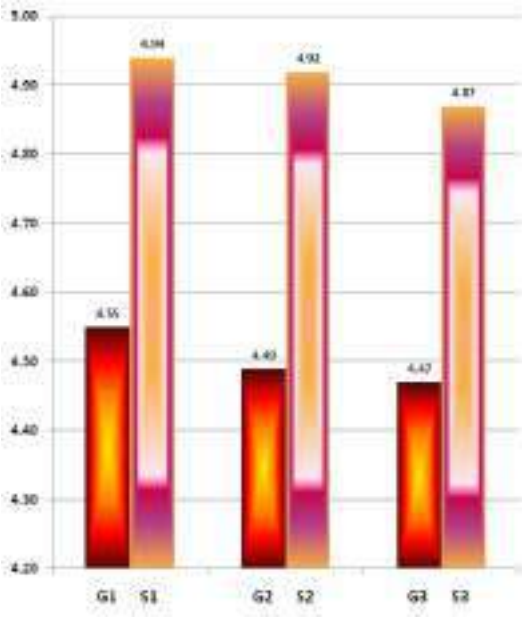

Fig. 4.0- Lactose (%) in Goat and Sheep milk

(5) Ash (%)

Table 5.0 and Fig. 5.0 presents the data on ash percentage in raw milk of Goat and Sheep. The results contained in the Table showed that Goat and Sheep milk registered mean ash percentage as 0.72, 0.71, 0.72 (overall 0.72) and 0.67, 0.69, 0.67 (overall 0.68), respectively. The differences in these values due to three animals each as well as due to replication were significant .Ash percentage was lower in Sheep milk.

Table - 5.0 : Ash (%) in Goat and Sheep milk

Sl. No.	Replica-tion	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	0.70	0.68	0.67	**0.68**	0.66	0.67	0.67	**0.67**
2	R_2	0.73	0.70	0.72	**0.72**	0.66	0.66	0.65	**0.66**
3	R_3	0.70	0.69	0.70	**0.70**	0.66	0.70	0.64	**0.67**
4	R_4	0.73	0.70	0.73	**0.72**	0.68	0.70	0.70	**0.69**
5	R_5	0.72	0.71	0.71	**0.71**	0.68	0.68	0.66	**0.67**
6	R_6	0.73	0.73	0.72	**0.73**	0.67	0.70	0.68	**0.68**
7	R_7	0.73	0.72	0.72	**0.72**	0.65	0.67	0.62	**0.65**
8	R_8	0.73	0.73	0.73	**0.73**	0.70	0.74	0.73	**0.72**
9	R_9	0.73	0.72	0.72	**0.72**	0.73	0.73	0.70	**0.72**
10	R_{10}	0.74	0.73	0.73	**0.73**	0.65	0.65	0.63	**0.64**
Range	Minimum	0.70	0.68	0.67		0.65	0.65	0.62	
	Maximum	0.74	0.73	0.73		0.73	0.74	0.73	
	Mean	**0.72**	**0.71**	**0.72**	**0.72**	**0.67**	**0.69**	**0.67**	**0.68**
F- test					S				S
S. Ed. (±)					0.01				0.01
C. D. (P = 0.05)					0.01				0.02

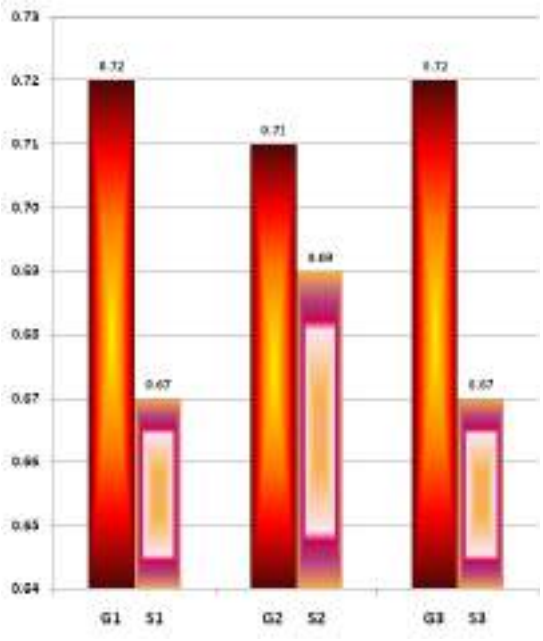

Fig. 5.0- Ash (%) in Goat and Sheep milk

(6) Total solid (%)

The data on total solid percentage in raw milk of Goat and Sheep is presented in Table 6.0 and Fig. 6.0. The results contained in the Table showed that Goat and Sheep registered mean total solid percentage as 12.58, 12.81, 12.70 (overall 12.70) and 17.98, 18.30, 18.50 (overall 18.26) respectively. The difference in these values due to animals was found significant, whereas due to replication, the differences were non-significant. Total solid percentage was higher in Sheep milk.

Table - 6.0 : Total Solid (%) in Goat and Sheep milk

Sl. No.	Replica-tion	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	12.65	12.70	12.65	**12.67**	18.00	18.50	18.50	**18.33**
2	R_2	12.55	12.85	12.70	**12.70**	18.00	18.00	18.50	**18.17**
3	R_3	12.60	12.90	12.75	**12.75**	18.00	18.00	18.50	**18.17**
4	R_4	12.55	12.90	12.70	**12.72**	18.00	18.50	18.50	**18.33**
5	R_5	12.50	12.80	12.70	**12.67**	18.00	18.50	18.50	**18.33**
6	R_6	12.60	12.80	12.80	**12.73**	18.25	18.50	18.50	**18.42**
7	R_7	12.55	12.85	12.65	**12.68**	18.00	18.00	18.50	**18.17**
8	R_8	12.65	12.75	12.75	**12.72**	17.75	18.50	18.50	**18.25**
9	R_9	12.60	12.80	12.60	**12.67**	17.75	18.25	18.50	**18.17**
10	R_{10}	12.55	12.75	12.65	**12.65**	18.00	18.25	18.50	**18.25**
Range	Minimum	12.50	12.70	12.60		17.75	18.00	18.50	
	Maximum	12.65	12.90	12.80		18.25	18.50	18.50	
	Mean	**12.58**	**12.81**	**12.70**	**12.70**	**17.98**	**18.30**	**18.50**	**18.26**
F- test					S				S
S. Ed. (±)					0.05				0.13
C. D. (P = 0.05)					0.10				0.26

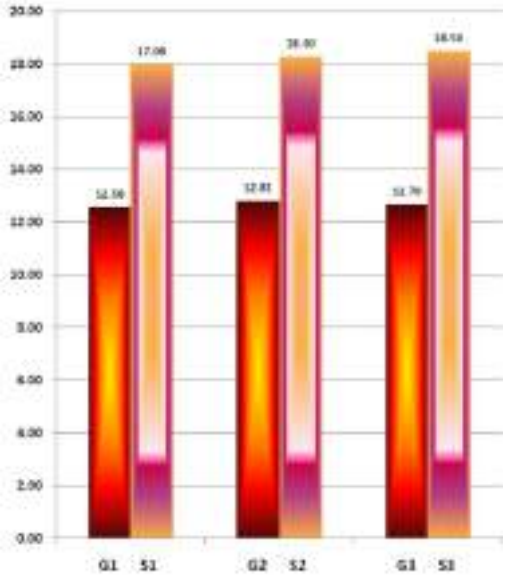

Fig. 6.0- Total Solid (%) in Goat and Sheep milk

(7) Water (%)

The data on water percentage in raw milk of Goat and Sheep is presented in Table 7.0 and Fig. 7.0. The results contained in the Table showed that Goat and Sheep milk registered mean water percentage as 87.42, 87.19, 87.31 (overall 87.31) and 82.03, 81.70, 81.50 (overall 81.74) respectively. The difference in these values due to animals has been found significant, but due to replication, the result was non-significant. Water percentage was lower in Sheep milk.

Table - 7.0 :Water (%) in Goat and Sheep milk

Sl. No.	Replication	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	87.35	87.30	87.35	**87.33**	82.00	81.50	81.50	**81.67**
2	R_2	87.45	87.15	87.30	**87.30**	82.00	82.00	81.50	**81.83**
3	R_3	87.40	87.10	87.25	**87.25**	82.00	82.00	81.50	**81.83**
4	R_4	87.45	87.10	87.30	**87.28**	82.00	81.50	81.50	**81.67**
5	R_5	87.50	87.20	87.30	**87.33**	82.00	81.50	81.50	**81.67**
6	R_6	87.40	87.20	87.20	**87.27**	81.75	81.50	81.50	**81.58**
7	R_7	87.45	87.15	87.35	**87.32**	82.00	82.00	81.50	**81.83**
8	R_8	87.35	87.25	87.25	**87.28**	82.25	81.50	81.50	**81.75**
9	R_9	87.40	87.20	87.40	**87.33**	82.25	81.75	81.50	**81.83**
10	R_{10}	87.45	87.25	87.35	**87.35**	82.00	81.75	81.50	**81.75**
Range	Minimum	87.35	87.10	87.20		81.75	81.50	81.50	
	Maximum	87.50	87.30	87.40		82.25	82.00	81.50	
	Mean	**87.42**	**87.19**	**87.31**	**87.31**	**82.03**	**81.70**	**81.50**	**81.74**
F- test					S				S
S. Ed. (±)					0.05				0.13
C. D. (P = 0.05)					0.10				0.26

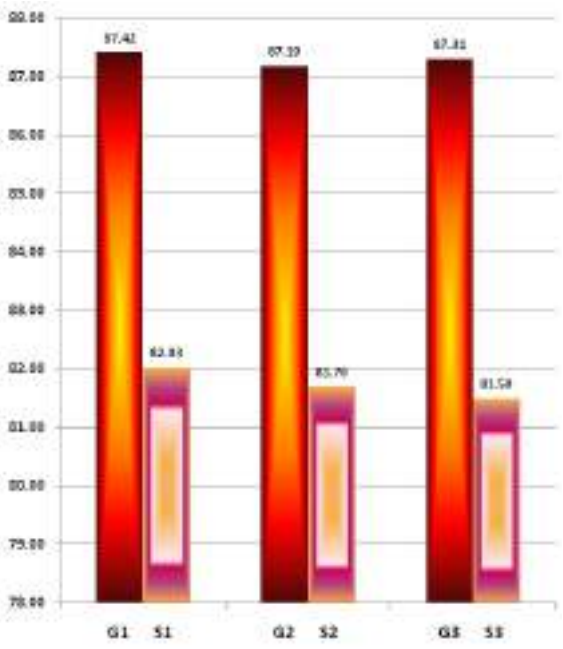

Fig. 7.0- Water (%) in Goat and Sheep milk

(8) Solid not fat (SNF) (%)

Table 8.0 and Fig. 8.0 presents the data on SNF percentage in raw milk of Goat and Sheep. The results presented in the Table showed that Goat and Sheep registered mean SNF percentage as 8.83, 8.95, 8.88 (overall 8.89) and 9.37, 9.76, 9.91 (overall 9.68), respectively. The differences in these values due to animals were significant, whereas due to replication the differences were non-significant. SNF content in Sheep milk was higher than that in Goat milk.

Table - 8.0 : Solid not fat (%) (SNF) in Goat and Sheep milk

Sl. No.	Replica-tion	Goat (G)			Mean	Sheep (S)			Mean
		G_1	G_2	G_3		S_1	S_2	S_3	
1	R_1	8.91	8.85	8.85	**8.87**	9.45	10.00	9.90	**9.78**
2	R_2	8.80	8.95	8.85	**8.87**	9.40	9.45	9.95	**9.60**
3	R_3	8.80	9.05	8.95	**8.93**	9.35	9.45	9.95	**9.58**
4	R_4	8.75	9.05	8.90	**8.90**	9.40	10.00	9.90	**9.77**
5	R_5	8.75	9.00	8.95	**8.90**	9.35	9.95	9.90	**9.73**
6	R_6	8.85	8.95	8.90	**8.90**	9.60	9.90	9.85	**9.78**
7	R_7	8.80	8.95	8.80	**8.85**	9.40	9.45	9.85	**9.57**
8	R_8	8.90	8.90	8.95	**8.92**	9.10	9.95	9.90	**9.65**
9	R_9	8.90	8.90	8.75	**8.85**	9.25	9.70	9.95	**9.63**
10	R_{10}	8.80	8.90	8.90	**8.87**	9.40	9.75	9.90	**9.68**
Range	Minimum	8.75	8.85	8.75		9.10	9.45	9.85	
	Maximum	8.91	9.05	8.95		9.60	10.00	9.95	
	Mean	**8.83**	**8.95**	**8.88**	**8.89**	**9.37**	**9.76**	**9.91**	**9.68**
F- test					S				S
S. Ed. (±)					0.06				0.13
C. D. (P = 0.05)					0..12				0.26

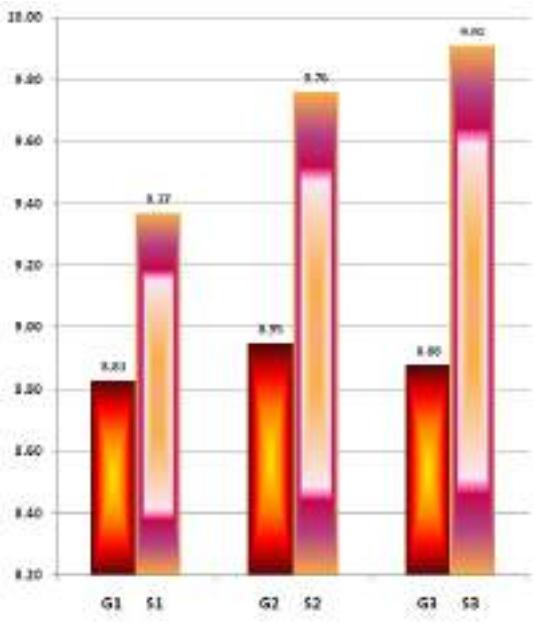

Fig. 8.0- Solid not fat (%) (SNF) in Goat and Sheep milk

The results of the investigation regarding the chemical qualities of milk of Goat and Sheep, have been presented in tables, graphically represented, and discussed in the preceding chapters.

Results of the experiment are summarized below:

1. Higher protein percentage was recorded in the milk of Sheep as compared to Goat milk.
2. Specific gravity of Sheep milk was higher as compared to Goat milk.
3. Fat percentage was recorded higher in the milk of Sheep followed by Goat milk.
4. Milk of Sheep recorded higher lactose percentage followed by Goat milk.
5. Lower ash percentage was found in the Sheep milk as compared to Goat milk.
6. Total solid percentage in Sheep milk was found higher than that in Goat milk.
7. Water content was recorded lower in the milk of Sheep as compared to Goat milk.
8. Solid not fat (SNF) was found higher in Sheep milk followed by Goat milk.
9. Based on the above results, chemical qualities of Sheep milk was found superior than Goat milk.

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Journal of Natural Resource and Development 16 (1) 79-82, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

COMPOSITIONAL QUALITY OF FRESH RAW MILK AS INFLUENCED BY STAGE OF LACTATION OF CROSSBRED COWS AT SHIATS DAIRY FARM

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Received : 01.11.2020 Accepted : 07.12.2020

ABSTRACT

Quality of milk includes the chemical and microbial attributes which is of great importance to the dairy farmers and industry, because of minimum legal standards and payment based on fat and S.N.F. by dairies. The knowledge of factors affecting milk composition, especially the levels of fat, proteins, lactose and ash is of utmost importance because these ingredients in milk are used for determining chemical quality of milk. Mean fat per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month were 3.72, 3.46 and 3.74. Mean protein per cent in raw milk of crossbred cow were 3.48, 3.34 and 3.37. Mean lactose per cent in raw milk of crossbred cow were 3.84, 4.22 and 4.24. Mean ash per cent in raw milk of crossbred cow were 0.65, 0.66 and 0.64. Mean SNF per cent in raw milk of crossbred cow were 8.02, 8.30 and 8.18. Mean T.S. per cent in raw milk of crossbred cow were 12.82, 11.59 and 12.95. Mean water per cent in raw milk of crossbred cow were 87.18, 87.18 and 87.14. Mean sp. gr. Per cent in raw milk of crossbred cow were1.027, 1.028 and 1.028. Mean acidity per cent in raw milk of crossbred cow were 0.15, 0.16 and 0.16. The results revealed that except lactose and SNF all the ingredients of milk were significantly influenced by lactation stage. Acidity was more in milk (1-3 month). Ash was more in milk (3-6 month). Fat, total solid, sp. gr. and water were more in milk (6-9 month).

Keywords : *Quality, raw milk, crossbred cows*

INTRODUCTION

Milk is one of the most complete foods in nutritional terms; it is rich in nutrients essential for growth and maintenance of a healthy life **(Vilela, 2002)**[13]. The importance of adding milk to the human diet is because of its richness in proteins, fats, carbohydrates (lactose), mineral salts, vitamins, conjugated linoleic acid, and sphingomyelin, butyric acid, among other substances, which provide immunologic protection and essential nutrients to its consumers **(Sordillo *et al.,* 1997; Oliveira *et al.*, 1999)**[12,9]**.**

Milk is a clean lacteal secretion obtained from complete milking of healthy milch animals properly fed and kept, excluding that obtained within 15 days before and 5 days after calving from

nutrition point of view milk is the most nearly perfect food to us. Body needs more than thirty different materials in food. No. single food stuff in nature supplies all but milk supplies nearly all the nutrients.Milk basically, is a primary source of nutrition for young mammals. For mankind, milk and milk products are excellent high quality foods, providing nutrients and play important role in diet for different ages. It is nearly a complete food as it contains carbohydrates, protein, fats, vitamins, mineral elements and water. The compositional quality of milk, nevertheless, is very important in dairy technology as it indicates milk process ability (Ozrenk and SelcukInci, 2008)[10]. Several reports have concluded that compositional quality of bovine milk is affected by stage of lactation, season, diet, dam age, physiological status, environmental conditions, region of production in addition to the genetic background (Slots *et al.,* 2009; Mapekula *et al.,* 2011; Frelich *et al.,* 2012, Myburgh *et al.,* 2012 and Lee *et al.,* 2014)[11, 4, 2, 6, 3]. Moreover, milk composition may also be changed over period of time and may vary from place to another as a result of interaction effects of several factors. The knowledge of factors affecting milk composition, especially the levels of fat, proteins, lactose and ash is of utmost importance because these ingredients in milk are used for determining chemical quality of milk. With this in view the present experiment entitled "Compositional quality of fresh raw milk as influenced by stage of lactation crossbred cows at SHIATS Dairy Farm".

MATERIALS AND METHODS

The present study was conducted to determine the chemical quality of milk as influenced by stage of lactation and milk production in cows of SHIATS Dairy Farm, Allahabad. The period of experiment was three months. Cows in herd were subjected to Californan Mastitis Test (CMT) and only healthy cows free from any noticeable injury on the udder showing negative CMT were selected in the experiment. Samples were collected from the milking pail after milking of cows to lactation stage 1 to 3 month, 3 to 6 month and 6 to 9 month. Then samples were brought immediately to laboratory for determination of chemical constituents of raw milk. Samples were collected from the milking pail separately in sterile 250 ml conical flasks and plugged aseptically with cotton plug. The samples were then brought immediately to the laboratoryfor determination of total solid (%), fat (%), solid not fat (%), protein (%), lactose (%), ash (%), specific gravity (cc), and water (%) as per the procedure and norms set by AOAC (2000)[1]. The data obtained for the aforesaid tests were subjected to statistical analysis.

RESULTS AND DISCUSSION

In general mean fat per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 3.72, 3.46 and 3.74. The differences in fat per cent in raw milk of crossbred cows due to lactation stage were not significant. Mean protein per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 3.48, 3.34 and 3.37. The differences in protein per cent in raw milk of crossbred cows due to lactation stage were not significant. Mean lactose per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 3.84, 4.22 and 4.24. The differences in lactose per cent in raw milk of crossbred cows due to lactation stage were significant. Mean ash per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 0.65, 0.66 and 0.64. The differences in ash per cent in raw milk of crossbred cows due tolactation stage were not significant. Mean SNF per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 8.02, 8.30 and 8.18. The differences in SNF per cent in raw

milk of crossbred cows due to lactation stage were significant. Mean T.S. per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 12.82, 11.59 and 12.95. The differences in T.S. per cent in raw milk of crossbred cows due tolactation stage were not significant. Mean water per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 87.18, 87.18 and 87.14. The differences in water per cent in raw milk of crossbred cows due to lactation stage were not significant. Mean sp. gr. per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 1.027, 1.028 and 1.028. The differences in sp. gr. per cent in raw milk of crossbred cows due to lactation stage was lactation stage were not significant. Mean acidity per cent in raw milk of crossbred cow in 1-3 month, 3-6 month and 6-9 month was 0.15, 0.16 and 0.16. The differences in acidity per cent in raw milk of crossbred cows due to lactation stage were not significant.

Fig. 1: Mean values of different ingredients in milk. (Stage of lactation)*- significant

Parameters	Mean values of parameters in milk		
	1-3 month	3-6 month	6-9 month
Fat per cent	3.72	3.46	3.74
Protein per cent	3.48	3.34	3.37
Lactose per cent	3.84*	4.22	4.24
Ash per cent	0.65	0.66	0.64
SNF per cent	8.02*	8.30	8.18
T. S. per cent	12.82	11.59	12.95
Water per cent	87.18	87.18	87.14
SP. Gr.	1.027	1.028	1.028
Acidity per cent	0.16	0.15	0.15

CONCLUSION

On the basis of the results obtained, it was concluded that the chemical quality of raw milk of crossbred cows was not influenced by stages of lactation. The results revealed that except lactose and SNF all the ingredients of milk were significantly influenced by lactation stage. Acidity was more in milk (1-3 month). Ash was more in milk (3-6 month). Fat, total solid, sp. gr. and water were more in milk (6-9 month).

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Journal of Natural Resource and Development 16 (1) 83-86, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON ROOT GROWTH OF RADISH (RAPHANUS SATIVUAS. L) CV. KASHI SHWETA

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Received : 12.12.2020 Accepted : 15.01.2021

ABSTRACT

The experiment on Radish was conducted in the department of Horticulture, Kulbhashkar Ashram Post Graduate College, Prayagraj during 2018-19.Root length root diameter and root weight was significantly influenced by treatments organic matter has very much influence on root parameters. Maximum root length (16.80cm) was recorded inT1 (FYM@10t/ha) followed byT3 (NPK Liquid consortia@100 ml/10 kg seed) treatment that is 16.76cm. Diameter of root was also showed similar pattern and maximum diameter (3.26cm) was recorded in T3 followed by (3.11cm)in T3 treatment . Root weight was alwso maximum (144.10g) in T1 treatment.

Keywords : *Effect, integrated, nutrient management root growth*

INTRODUCTION

Radish has cooling effect, prevents constipation and increase appetite. It is recommended for patients suffering from piles, liver troubles and jaundice. The juice of fresh leaves is used as dietary and laxative. It is rich in dilatory fiber, help in skin disorder, controlling the blood pressure due to presence of minerals like Fe, Na and Ca, radish seeds can promote the formation and strengthening of bones (seed contain high amount of Ca). It is used for pickle. In homeopathy, it is used for neurological, headache sleeplessness and chronic diarrhea.

Radish *(Raphanus sativus L.)* is a popular root vegetable in both tropical and temperate regions of Cruciferae (Brassicaceae) family grown all over world. In India, it is widely cultivated in northern and southern plains as well as in hills. Radish (2n=18) is grown for its young tender fusiform root which is consumed either raw as salad or cooked as a vegetable.The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish

MATERIALS AND METHODS

Field experiment entitled "Effect of Integrated Nutrient Management on root growth of Radish (Raphanus Sativus L.)" was conducted at the Horticulture Farm K.A.P.G. Allahabad Utter Pradesh during rabi season 2019-20. The details of the procedure adopted for Crop raising and criteria used for treatment evaluation during entire course of investigation are described here. The experiment consists of 8 treatments combinations comprising of organic manures with and without biofertilizer (viz. NPK liquid consortia Bio). The details are as below.

Table - 1 : Details of treatments used in study

S. NO.	Treatment symb.	Treatment detail
1.	T_0	Control unit (no use fertilizer)
2.	T_1	Azotobactor
3	T_2	PSB(phosphorus soluble bacteria)
4.	T_3	FYM@10t/ha
5.	T_4	Vermicompost@4t/ha
6.	T_5	FYM+Azotobactor
7.	T_6	FYM+PSB
8.	T_7	Vermicompost+Azotobactor
9.	T_8	Vermicompost+PSB
10.	T_9	Azotobactor+PSB

RESULTS AND DISCUSSION

The results of the field experiment were carried out to study. The "Effect of Integreted Nutrient management on root growth of Radish (Raphanus Sativus L.)" conducted at Horticulture Farm. Kulbhaskar Ashram Post Graduate College, Allahabad, U. P. are presented in this chapter.

Root Length (cm):

Length of root (cm) was observed at harvesting stage. The data presented in Table 2. Length of root in radish was significantly affected with different treatments. Maximum root length (16.8cm), was observed in application of FYM (T1) followed by (16.76 cm.) NPK liquid consortia (T3) compared to other treatments. Respectively, minimum length of root (15.26cm) was observed in control plot (T0) followed by (15.36 cm.) FYM+ Vermicompost+ NPK liquid consortia (T7) . Patil *et al*. (2007) reported that the significantly higher plant height and number of seed stalks per plant in onion were recorded with the application of FYM @ 10, 15 and 20t per ha than 5t/ha. Chaudhari (2011): reported that the combined application of biofertilizers (Azospirillum and Phosphobacteria) along with inorganic fertilizers at 75% of recommended dose of N, P and 100% K favorably influenced the growth and yield (530.08q/ha) of brinjal cv. GoB-1.

Table - 2 : Effect of INM (biofertilizer and organic manures) on root length in radish

Treatment Symbol	Treatments Details	Root length/ Plant
T_0	Control unit (No use of fertilizer) 1	15.26
T_1	FYM@10t/ha	16.8
T_2	Vermicompost@4t/ha	16.26
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment	16.76
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha	15.7
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat	15.86
T_6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat.	15.43
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed treat.	15.36
	SEm±	0.9490
	C.D. at 5% level	2.878

Diameter of root (cm):

Diameter of root (cm) was observed at harvesting stage. Perusal of data presented in Table 3. The maximum average diameter of root at harvesting stage (3.26 cm), was recorded with the application of FYM (T1) followed by (3.11cm) NPK liquid consortia (T3) compared to other treatments. Respectively, minimum average diameter of root per plant (2.64 cm) was recorded in control plot (T0) followed by (2.68m) FYM+Vermicompost+ NPK liquid consortia (T7). Kanaujia and Singh (2012) and vimera *et al*. (2012): conducted an experiment on INM and found 50% of NPK + 50% of FYM + biofertilizers recorded maximum yield of carrot. Their combination had a beneficial impact on carotene content in roots. Maximum carotene (3.41mg/l00g) was recorded with 50% NPK + 50% FYM biofertilizer. Bairagi and Singh (2013): was found that the application of 150:60:120 kg NPK/ha + 50 Kg N, substituted through FYM proved to be gave the best result in maximum canopy spread (77.00cm), maximum corm weight per plant (2.64kg) as well as total corn yield (44.24q/ha).

Table - 3 : Effect of INM (biofertilizer and organic manures) on root diameter of radish

Treatment symbol	Treatments Details	Root Diameter/ plant (cm)
T_0	Control unit (number of use of fertilizer)	2.64
T_1	FYM @10t/ha	3.26
T_2	Vermicompost@4t/ha	3.03
T_3	NPK Liquid consortium (biofertilizer) @ 100ml/10kg seed treatment.	3.11
T_4	(5tonnes FYM+2 tonnes vermicompost) ha.	2.9
T_5	5 tonnes FYM/ha + 50ml NPK liquid consortium (bio-fertilizer)/10kg seed treat.	2.92
T_6	2 tonnes vermicompost/ha. + 50ml NPK liquid consortion (Bio-fertilizer)/10 kg seed treat.	2.83
T_7	3.3 tonnes FYM / ha + 1.33 tonnes vermicompost /ha +33.33 ml NPK liquid consortion/10kg seed treat.	2.68
	SEm±	**0.169**
	C.D. at 5% level	**0.514**

Root weight (gm):

Root weight of the yield at harvesting stage. Perusal of data presented in Table 4.

The maximum average root weight at harvesting stage (64.14 gm) was recorded with the application of FYM (T1) followed by (62.02 gm) NPK liquid consortia (T3) compared to other treatments. Respectively, minimum root weight per plant (53.96 gm) was recorded in control plot (T0) followed by (56.14 gm) FYM+vermicompost+ NPK liquid consortia (T7). Sharma *et al*. (2013): conducted an experiment on cabbage crop using Azotobacter, Azospirillum and VAM. The results proved that 4 kg/ha dose of each biofertilizer resulted the maximum plant height, number of leaves per plant, diameter of stem, length of longest leaf, broadest leaf and plant spread than other doses.

Table - 4 : Effect of biofertilizer and organic manures on root weight of radish

Treatment Symbol	Treatments Details	Root Weight (gm)
T_0	Control unit (No use of fertilizer)	53.96
T_1	FYM @10t/ha	64.15
T_2	Vermicompost @4t/ha	59.88
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment	62.02
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha	57.96
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat.	58.92
T_6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat	57.34
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed treat.	56.14
	SEm ±	**8.08**
	C.D. at 5% level	**24.51**

Root weight with top (gm):

Total weight of the yield at harvesting stage. Perusal of data presented in Table 5. The maximum average total root weight at harvesting stage (14.10 gm.) was recorded with the application of FYM

(T1), followed by (140.08 gm.) NPK liquid consortia (T3) compare to other treatments.

Respectively, minimum total weight per plant (116.74 gm) was recorded in control plot (T0) followed by (125.92 gm) FYM+vermicompost+ NPK liquid consortia (T7). Kumar *et al.* (2014): reported that the influence of organic source of nutrients on growth and yield of radish cv. Japanese White. The experiments consisted of 11 treatments laid out in R.B.D. with 3 replications. The growth parameter recorded at 15 days interval. It was seen that the plant weight was significantly increased by the application by 82.68, 132.9 and 167.6% respectively compared to control unit.

Table - 5 : Effect of biofertilizer and organic manures on root weight of radish

Treatment Symbol	Treatments Details	Root Weight (gm)
T_0	Control unit (No use of fertilizer)	116.74
T_1	FYM @10t/ha	144.10
T_2	Vermicompost @4t/ha	134.4
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment	140.08
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha	131.86
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat.	133.12
T_6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat.	130.56
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed treat.	125.92
	SEm ±	**14.76**
	C.D. at 5% level	**44.7818**

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Journal of Natural Resource and Development 16 (1) 87-90, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON VEGETATIVE GROWTH OF RADISH (RAPHANUS SATIVUAS. L) CV. KASHI SHWETA

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Received : 25.12.2020 Accepted : 30.01.2021

ABSTRACT

The experiment on Radish was conducted in the Department of Horticulture, Kulbhashkar Ashram Post Graduate College, Prayagraj during 2018-19.Vegetative growth was found to influence by organic treatments. All the treatments were significantly better over control. Organic matter as well as bio-inoculants have great impact on vegetative growth of radish plant..Maximum plant height (31.28 cm) was recorded in T1 (FYM@10 t/ha.) .The next best result was found in T3 (NPK Liquid consortium@100ml/10kg seed). Number of leaves per plant and leaf area was also better in T1 and T3 respectively. Minimum plant height, leaf area and number of leaves were in control.

Keywords : *INM, radish, vegetable growth.*

INTRODUCTION

Radish *(Raphanus sativus L.)* is a popular root vegetable in both tropical and temperate regions of Cruciferae (Brassicaceae) family grown all over world. In India, it is widely cultivated in northern and southern plains as well as in hills. Radish (2n=18) is grown for its young tender fusiform root which is consumed either raw as salad or cooked as a vegetable.The integrated nutrient management system approach, utilizes a judicious combination of inorganic fertilizer and organic manure build soil fertility and to increase the production of crop (Kumar et *al.* 2013). In India radish is cultivated on area of 206.00 (000 ha) with total production of 3252.00 (000MT) during 2018-19 as per NHB data base. It is cultivated throughout India, mostly in West Bengal, Bihar, U.P., M.P, Punjab, Assam, Haryana, Gujarat, and. H.P. In U.P. In U.P. Jaunpur district is popular in production and quality of radish

MATERIALS AND METHODS

Field experiment entitled "Effect of Integrated Nutrient Management on vegetative growth of Radish (Raphanus Sativus L.)" was conducted at the Horticulture Farm K.A.P.G. Allahabad Utter Pradesh during rabi season 2019-20. The details of the procedure adopted for Crop raising and criteria used for treatment evaluation during entire course of investigation are described

here. The experiment consists of 8 treatments combinations comprising of organic manures with and without biofertilizer (viz. NPK liquid consortia Bio). The details are as below.

Table - 1 : Details of treatments used in study

S. NO.	Treatment symb.	Treatment detail
1.	T_0	Control unit (no use fertilizer)
2.	T_1	Azotobactor
3	T_2	PSB(phosphorus soluble bacteria)
4.	T_3	FYM@10t/ha
5.	T_4	Vermicompost@4t/ha
6.	T_5	FYM+Azotobactor
7.	T_6	FYM+PSB
8.	T_7	Vermicompost+Azotobactor
9.	T_8	Vermicompost+PSB
10.	T_9	Azotobactor+PSB

RESULTS AND DISCUSSION

The results of the field experiment were carried out to study. The "Effect of Integreted Nutrient management on vegetative growth of Radish (Raphanus Sativus L.)" conducted at Horticulture Farm. Kulbhaskar Ashram Post Graduate College, Allahabad, Utter Pradesh are presented in this chapter.

Plant height (cm):

Plant height was recorded at harvesting stage. Perusal of data presented in Table 2 revealed significant effect of Bio fertilizer, organic manure and their combination on plant height of radish.

The maximum average plant height at harvesting (31.28 cm) was recorded with the application of FYM (T1), followed by (31.15 cm) NPK liquid consortia Liquid (Biofertilizer, T3) compared to other treatment. Respectively, minimum average plant height (27.91 cm) was recorded in control plot (T0), followed by (29.66 cm) FYM + Vermicompost + NPK liquid consortium (T7). Schulz *et al*. (2000) reported that in nine hybrid of carrot *(Doucus carota L.)* and 3 seed cultivars were evaluated under organic cultivation at Giessen. Most hybrids had high yields, good quality traits, while more medium yielding true seed varieties showed insufficient external quality and composition.

Table - 2 : Effect of Integrated nutrient management(organic , biofertilizer and their combination) on plant height of radish

Treatments Symbol	Treatments Details	Plant height(cm)
T_0	Control unit (No use of fertilizer)	27.91
T_1	FYM @10t/ha	31.28
T_2	Vermicompost@4t/ha	30.58
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment.	31.15
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha.	29.91
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat	30.35
T_6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat.	29.75
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed treat.	29.66
	SEm±	**1.731**
	C.D.at 5% Level	**5.252**

Number of leaves per plant:

Number of leaves per plant was recorded at harvesting stage. Perusal of data presented in Table 3 revealed significant effect of biofertilizer, organic manures and their combination on number of leaves per plant in radish.

The maximum average number of leaves per plant at harvesting stage (10.42) was recorded with the application of FYM (T1) followed by (10.30) NPK liquid consortia (T3) compared to

other treatments. Respectively, minimum average number of leaves per plant (9.0) was recorded in control plot (T0) followed by (9.76), FYM + Vermicompost + NPK liquid consortia (T7). Panwar *et al*. (2001) reported in radish *(Raphanus sativus L.)* that maximum growth occurred with the application of nitrogen dose 120 kg/ha in plants inoculated with Azotobacter + Azospirillum. Uddin *et al.* (2004) reported that the different combination of NPK and cow dung showed significantly influence on the yield of carrot the combination of fertilizer 120-45,-120-30 kg ha-1 or NPK and 5t/ha cow dung produced highest yield 27.22 t/ha which was 303% higher over control treatments.

Table - 3 : Effect of INM (biofertilizer, organic manures and their combination) on number of leaves per plant in radish.

Treatment symbol	Treatments Details	Level /plant
T_0	Control unit (No use of fertilizer)	9.0
T_1	FTM@10t/ha	10.42
T_2	Vermicompost@4t/ha	10.13
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment.	10.30
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha.	9.8
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat.	10.1
T^6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat.	9.8
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed treat.	9.76
	SEm±	0.435
	C.D.at 5% level	1.322

Leaves area/plant (cm biofertilizer and organic manures on radish:

Fig. 4 : Leaves area/plant (cm2) as affected by biofertilizer and organic manures on radish plants Area/Plant at harvesting stage (43 DAS) 291.5 T7) as affected by biofertilizer and organic manures on radish . Shunmugasundaram and Savitri (2002) reported that the effect of nitrogen fertilizer, singly (60,120, 180 and 240 kg /ha) or in combination (120kg/ha) with lime (5t ha-1), farmyard manure (10t ha-1), Neem coated urea, biofertilizers (Azotobacter and Phosphobacterium each at 2kg ha -1) or lime was applied one month before sowing, where as FYM and biofertilizer were broad casted before sowing, Nitrogen @ 240kg/ha-1 resulted in the highest root yield (57.7 t ha-1). Kamalakannam and Manivannan(2002) recorded maximum yield with 100 percent NPK + FYM @ 10t/ha in carrot. They further reported maximum root length, width with 100 percent NPK + Azospirilum in radish and carrot. Sharma *et al*. (2003) obtained that the highest root yield (32.26t ha-1) of carrot was for plants treated with ½ RDF +½ FYM + Rhizobium bacteria, followed by RDF (29.53t/ha) while maximum root yield (20.01 t/ha) was for controls. Highest value of Vit-A (997.52IU) was observed in plants treated with 1/2 RDF+1/2 FYM+Rrhizosphere bacteria.

Table 4: Effect of INM (biofertilizer and organic manures) on leaves area per plant of radish.

Treatments symbol	Treatment Details	Area /plant
T_0	Control unit (No use of fertilizer)	286.33
T_1	FYM@10t/ha	351.04
T_2	Vermicompost@4t/ha	332.33
T_3	NPK Liquid consortium (Biofertilizer) @ 100ml/10kg seed treatment.	333.37
T_4	(5 tonnes FYM+ 2 tonnes Vermicompost)/ha	320.16
T_5	5 tonnes FYM/ha+ 50ml NPK liquid consortium (Bio fertilizer)/10 kg seed treat.	327.41
T_6	2 tonnes Vermicompost/ha+ 50ml NPK Liquid consortium (Bio fertilizer)/10 kg seed treat	318.95
T_7	3.3 tonnes FYM/ha+ 1.33 tonnes vermicompost/ha +33.33ml NPK liquid consortium/10 kg seed trea	291.50
	SEm±	39.43
	C.D.at 5% level	119.624

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Journal of Natural Resource and Development 16 (1) 91-98, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

FEEDING GARLIC (ALLIUM SATIVUM) TO GOATS: EFFECT ON FEED INTAKE AND GROWTH PERFORMANCE

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Received : 11.03.2021 Accepted :15.04.2021

ABSTRACT

Two different experiments were conducted using fifteen growing lambs and fifteen fattening goats of Barbari breed with average weight of 17.4 and 21.1 kg and age of between 12 and 20 months respectively to evaluate supplemented garlic levels on performance of the animals. In each experiment, the animals were randomly assigned to three treatment diets containing graded garlic levels in a completely randomized experimental design replicated five times. Garlic was supplemented at graded levels of 30gm and 60gm for treatments T2 and T3 respectively while treatment T1(control) had no garlic. Results indicated a significantly lower body weight gain for growing animals (experiment 1) fed diets containing garlic (P<0.05) while feed conversion ratio (FCR) and cost of feed/kg live weight gain was higher. For fattening animals (experiment 2), garlic inclusion above 30gm had a negative effect on fattening performance (P < 0.05). It was concluded that inclusion of garlic in the diet of growing and fattening Barbari goat could not improve performance.

Key words: *Barbari goat, fattening goat, garlic, growing goat, hathras.*

INTRODUCTION

Agriculture is the main driving force of her national economy where the components of agriculture are crop, livestock, fisheries and horticulture. Garlic (*Allium sativum*) has been a subject of considerable interest as a medicinal and therapeutic agent globally since ancient times. It was used as a remedy for intestinal disorders, flatulence, worms, respiratory infections, skin diseases, wounds, symptoms of ageing and many other ailments. Spices such as garlic (*Allium sativum*) to possess useful pharmacological potent chemical substances for use in animal nutrition used to enhance the performance of livestock. Garlic is used as natural additives to replace chemical additives to improve digestibility, nutritive value, and increase feed utilization, thus improve the performance of growing animals. Garlic extracts show anti-oxidation that consequently alleviates gastric mucosal damage. In addition to these attractive properties, herbs have been shown to increase feed palatability and thus feed intake (Horton *et al.,* 1991). Because of the antimicrobial, antioxidant and flavour enhancing properties of garlic, these herbs may promote growth and feed utilization in goat. That will open the new dimension

of the ban of antibiotic. Garlic as natural growth promoters can be potential alternatives for common artificial growth promoters like antibiotics (Demir *et al.,* 2003). Garlic (*Allium sativum*) consumed as a delicacy, medicine, or spice. Garlic which belong to the family Liliaceae and the genus Allium (Ebesunun *et al.,* 2007) is among the common medicinal plant used as growth promoters (Ali and Zahran, 2010). The main pharmacological effects of garlic are attributed to 'allicin', an organosulphur compound that exhibits antibacterial (Lanzotti, 2006; Toghyani *et al.,* 2011), antifungal, antiparasitic, antiviral (Ankri and Mirelman, 1999), antioxidant (Banerjee *et al.,* 2003; Lee *et al.,* 2009), hypocholesterolemic (Gupta and Porter, 2001), hypoglycemic and hypotensive action. The hypoglycemic property of garlic was reported by (Kumar and Reddy 1999) in rats and (Singh *et al.,* 2017) in broilers. Further the hypolipidemic property of garlic was demonstrated by (Omojola *et al.,* 2009) in pigs and (Prasad *et al*., 2009) in broilers. Also, Garlic has the capacity to increase the total protein, albumin and globulin concentrations as evident by the findings of (Hassan *et al.,* 2013) in growing buffalo calves. This study is aimed at evaluating supplemented Garlic levels on the performance of growing and fattening goat.

Garlic (Allium sativum), the wonder drug of the herbal world due to its multi functional benefits (Sikka and Singh 2009), possess at least 33 sulphur containing compounds, several enzymes, amino acid and minerals (Newall et al. 1996). The major active ingredients in garlic are allicin, ajoene, diakyl polysulphides, s-allylcysteine etc which may be responsible for the various properties of garlic (Canogullari et al. 2010). In vitro studies showed that garlic possess antibacterial, antifungal, antiparasitic, antiviral (Ankri and Mirelman 1999) and antioxidant (Prasad et al. 2009) properties. Suriya et al. (2012) suggested that inclusion of 0.5% garlic may have the potential to be an alternative to antibiotic growth promoter for broiler chicken. The present study was designed to evaluate the potential of incorporating three level of sun dried WBGP as a phytogenic alternative to antibiotic growth promoters in commercial broilers.

MATERIALS AND METHODS

Experimental location and climatic condition:

The experiment was conducted at the village level organised dairy farm, village Ruheri distract Hathras. Hathras is located at 27°36′N 78°03′E/27.6°N 78.05°E. It has an average elevation of 185 metres (606 feet). The temperature here averages 25.4 °C. In a year, the rainfall is 755 mm.

Experimental design, feed sourcing and diet formulation:

A complete randomized design (CRD) was used for the two experiments. Fifteen (15) experimental animals each were divided into three (3) dietary treatments replicated five times; each animal serving as replicate. The animals were balanced for weight at the start of the experiments. The Garlic was purchased from Hathras market together with other feed ingredients which includes Maize, Cowpea husk, Cotton seed cake, and Rice offal, Salt, and Mineral Mixture. Three diets were formulated for each study using supplemented Garlic levels. Diet 1 serves as control (without ginger inclusion) while Diets 2 and 3 were supplemented with garlic at the dose rate of 30 and 60 gm per kg body weight, respectively in their concentrate feed. The experimental diets were used to feed the 15 growing and the 15 fattening animals for 90 days. The diets were designated as diet 1, 2, and 3 in the experiments. Compositions of the experimental diets are shown in tables 1 and 2 respectively.

Data collection In each experiment, Feed and water intakes were calculated on daily basis. Feed intake was recorded by subtracting feed left over from quantity offered the previous day. Live weight changes were recorded on weekly basis after overnight fasting of the animals to avoid error due to gut fill.

Table - 1 : Composition of Experimental Diets for experiment 1.

Ingredients	**Treatments (garlic supplemented level gm)**		
	1 (0)	**2 (30gm)**	**3 (60gm)**
Maize	25	25	25
Cowpea husk	12	12	12
Cotton seed cake (CSC)	20	20	20
Rice offal	12	12	12
Bajra	30	30	30
Salt	0.50	0.50	0.50
Min. Mix	0.50	0.50	0.50
Total	**100**	**100**	**100**
Calculated nutrient contents			
Crude Protein (%)	16.00	16.00	16.00
Energy (kcalME/kg)	2200	2200	2200
Crude Fibre (%)	20	20	20
Ginger supplementation (gm)	0	30	60

Table - 2 : Composition of Experimental Diets for experiment 2.

Ingredients	**Treatments (supplemented garlic level (%)**		
Maize	35	35	35
Urd husk	16	16	16
Cotton seed cake	18	18	18
Bajra	28	28	28
Mineral mixture	2	2	2
Salt	1	1	1
Total	**100**	**100**	**100**
Calculated nutrient contents			
Calculated energy (ME Kcal/kg)	2600	2600	2600
Crude protein (%)	13	13	13
Calculated Fiber (%)	20	20	20
Ginger Supplementation (gm)	0	30	60

Table - 3 : Proximate composition of experimental diets for experiment 1.

Parameter (%)	**Treatments (garlic supplemented level gm)**		
	1(control)	**2(30)**	**3 (60)**
Dry matter (DM)	90.45	91.68	91.15
Crude protein (CP)	11.24	12.45	11.95
Crude fiber (CF)	22.47	26.86	28.13
Ether extract (EE)	5.95	5.32	4.51
Nitrogen free extract (NFE)	46.34	43.67	40.83

Table - 4 : Proximate compositions of the experimental diets for experiment 2.

Parameter (%)	Treatments (garlic supplemented level gm)		
	1(Control)	2 (30gm)	3 (60gm)
Dry matter (%)	93.87	94.69	95.16
Crude protein (%)	13.18	12.73	12.45
Crude fibre (%)	22.89	24.95	29.70
Ether extracts (%)	6.48	5.79	4.95
NFE (%)	49.28	45.73	42.13

Table - 5 : Performance of growing goat (experiment 1) fed varying levels of garlic.

Parameters	Treatments (garlic supplemented level gm)			
	1 (0gm)	2(30gm)	3(60gm)	SEM
Initial body weight (kg)	18.90	18.40	17.50	1.33
Final body weight	26.10a	20.600ab	18.30b	2.45
Total live weight gain (kg)	8.60a	3.30b	1.90b	1.60
Average daily gain (kg)	127.00a	45.00b	39.00b	27.11
Feed intake (kg/day)	1.40 a	0.83b	0.61b	0.18
Total feed intake (kg)	1183.27a	815.34ab	650.83b	127.25
Feed conversion ratio	6.61c	7.28b	7.95 a	0.003
Dry matter intake as %body weight (DMI as %BW)	4.59a	3.05ab	2.75b	0.235

abc means in the same row with different superscripts are significantly different ($p < 0.05$).

Table- 6: Feed intake, Feed conversion ratio and live weight gain of fattening goat fed graded levels of garlic.

Parameters	Treatments			
	1(Control)	2(30)	3(60)	SEM
Initial weight(Kg)	22.30	21.20	23.50	3.10
Final weight(Kg)	34.40	31.70	31.10	2.84
Total weight gain(Kg)	12.95a	11.55a	8.50b	1.04
Average daily gain (Kg/day)	181.0a	160.0ab	122.0b	20.42
Feed intake (Kg/day)	2.68a	2.49a	2.18b	0.23
Feed conversion ratio	6.10b	5.84b	8.92a	0.92
DMI as %body weight	6.18	6.42	6.02	0.29

Table - 7 : Cost of feed and cost feed/kg live weight of growing goat fed graded garlic levels.

Parameters	Treatments (garlic supplemented level gm)		
	1 (0gm)	2 (30gm)	3(60gm)
Total cost of feed consumed (Rs)	3632.50a	2298.60b	2825.40b
Cost of feed/ kg live weight (Rs)	110.80c	143.30b	271.10a

abc means in the same row with different superscripts are significantly different ($p < 0.05$).

Table - 8 : Cost of fattening Goat fed graded levels of garlic.

Parameter	Treatments		
	1(Control)	2(30gm)	3(60gm)
Total cost of feed consumed(TCFC)(Rs)	2852.30b	3595.60a	4031.90a
Cost of feed/kg live weight(Rs/ kg)	95.206c	176.30b	308.40a

abc means in the same row with different superscripts are significantly different ($p < 0.05$).

RESULTS AND DISCUSSION

Proximate composition of the experimental diets:

Result **(Table. 3)** showed that dry matter content of experimental diet varied from 90.45 to 91.68 %. Crude protein (CP) content varies from 11.24 to 12.45%. Crude fiber (CF) content increased as the level of Garlic increased. Ether extract decreased from treatment 1 to treatment 3 as ginger level increased.

The Dry Matter (DM) content of the experimental diet increases as the level of garlic increased. Crude Protein content decreased slightly as the level of ginger increased. Ether Extract and NFE values decreased from treatment 1 to treatment 3. Crude Fibre content increased as the inclusion level of garlic increased **(Table. 4).**

These results were supported by the findings of (Hassan *et al.,* 2013) and (Alagawany *et al.,* 2016) in growing buffalo calves and rabbits respectively. The additional energy available due to the essential oil from medicinal supplementation is used to improve performance and reduce body reserve losses (Tedeschi *et al.*, 2003). However, (Tager and Krause 2011) reported that dry matter intake was not affected by EOs supplementation in the diet.

Performance of growing goat fed graded levels of Garlic

Results **(Table. 5)** showed no significant difference ($p>0.05$) in initial body weight of the growing animals. Total live weight gain and average daily gain was higher ($p< 0.05$) for treatment 1 (control) compared to other treatments. Final weight, feed intake and dry matter as % body weight for treatments 1 and 2 are significantly higher ($p<0.05$). Feed conversion ratio (FCR) is significantly higher ($p< 0.05$) for animals fed diet containing higher garlic levels (garlic treatment 3).

Performance of fattening goat fed graded levels of Garlic

(Table. 6) indicated no difference ($P > 0.05$) between the treatments in initial weight, final weight and DMI as % BW. Treatments 1 and 2 has significantly higher total weight gain ($P <0.05$) compared to treatment 3. There is no significant difference ($P > 0.05$) in feed intake between treatments 1 and 2.

The present study was agreed with the study of (Onu and Aja 2011) who reported that final body weight was increased in garlic, ginger and mixture of garlic & ginger supplemented group compared to control group. The increased body weight was observed in this study strengthen the findings of (Ahmed and sharma, 1997) and (Ademola *et al*., (2009) who found significant increase of body weight gain of broiler fed a mixture of Garlic and Ginger. (Aji *et al.*, 2011) reported increase in weight gain of rabbits and broilers fed garlic supplemented diets respectively. This result of increasing body weight gain was differed with the finding of (Dieumou *et al.,* 2009) who reported no effect of garlic and ginger supplementation on body weight gain of broiler. However, this observation contradicts the reports of (Omage *et al.,* 2007), (Farinu *et al.,* 2009), (Ademola *et al.,* 2006) and

(Horton *et al.,* 1991).

Cost of growing goat fed graded levels of garlic

(Table: 7) Indicated no significant difference (P > 0.05) in Total cost of feed consumed between treatments 2 and 3. Cost of feed/kg live weight is significantly higher for animals fed higher garlic levels.

Cost of fattening Goat fed graded levels of garlic

(Table: 8) Indicated no significant difference (P > 0.05) in Total cost of feed consumed between treatments 2 and 3. Cost of feed/kg live weight is significantly higher for animals fed higher garlic levels. The present results are in agreement with (Hossain *et al.* 2014) who also reported significantly higher BCR with 1% garlic than the control. Cost of feed per kg live weight gain is an important indicator of economics of sheep production (Maigandi *et al.,* 2002).

Total cost of feed consumed is significantly higher (P< 0.05) for animals in treatment 1 compared to those in treatment 3. However, cost of feed/kg live weight kg was lower for the same group of animals (treatment 1).

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Journal of Natural Resource and Development 16 (1) 99-104, 2021 | NAAS RATING : 3.77 | ISSN-0974-5033

EFFECTS OF DIETARY INCLUSION OF PROBIOTIC ON GROWTH PERFORMANCE OF BROILER CHICKENS

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Received : 11.04.2021 Accepted : 15.05.2021

ABSTRACT

The purpose of this research work was to evaluate the probiotic (*Lactobacillus* sp.) on the growth performance of broiler chicken. Seventy two, day old broiler chicks were randomly assigned to four treatments T_0, T_1, T_2 and T_3. Each treatment was replicated three times with six chicks per replicate. The control(T_0) groups were fed a basal diet without any probiotic and other groups were fed the diets that consisted of 3 probiotic levels at initial concentrations of 1.0 × 106 cfu · g−1 (T_1), 2.0 × 106 cfu · g−1 (T_2), and 5.0 × 106 cfu · g−1 (T_3).The lowest final weight and daily weight gain were found in control groups ($P < 0.05$) and there were no significant differences among probiotic-treated groups. Significantly lower feed conversion ratio and higher survival rate were observed in T_2 and T_3 than that of the control. It was concluded from this study that the probiotic (*Lactobacillus* sp.) on the growth performance of broiler chicken. From economic point of view feed containing 2.0 × 106 cfu · g−1 (T_2), and 5.0 × 106 cfu · g−1 (T_3) the probiotic (*Lactobacillus* sp.)was better due to significantly lowest feed conversion ratio.

Keywords: Broiler, probiotic, growth performance, feed conversion ratio

INTRODUCTION

Feed is a major component, affecting net return from the poultry business, because 80% of the total expenditure in terms of cash is spent on feed purchase (Khan et al., 2010). To ensure more net return and to minimize high expenditure on feed are the main challenges, for which many research strategies have been practiced such as introducing feed supplements and feed additives (Khan et al., 2009). In the past the major growth promoters were antibiotics. However the current research is looking for natural alternative to antibiotics because of their residue and subsequent resistance to bacteria. At present the scientists are working to improve feed efficiency and growth rate of livestock using useful herbs (Khan et al., 2010). A probiotic, which means "for life" in Greek (Gibson and Fuller, 2000), has been defined as "a live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance" (Fuller, 1989). There are many reports concerning the effect of using probiotics including *Lactobacillus*,

Bifidobacterium, *Bacillus*, *Streptococcus*, *Pediococcus*, *Enterococcus*, and yeast such as *Saccharomyces cerevisiae*on chickens (Endo and Nakano, 1999; Mahajan et al., 2000;Aksu et al., 2005; Ahmad, 2006; Mountzouris et al., 2007). No study has been carried out on sporeforming lactic acid-producing bacteria such as *Bacillussp.* as probiotics in broiler chicken. The efficacy of probiotics may be potentiated by several methods: the selection of more efficient strains, gene manipulation, the combination of several strains, andthe combination of probiotics and synergistically actingcomponents. This approach seems to be the best wayof potentiating the efficacy of probiotics and is widelyused in practice. A way of potentiating the efficacy ofprobiotic preparations may be the combination of bothprobiotics and prebiotics as synbiotics, which may bedefined as a mixture of probiotics and prebiotics thatbeneficially affects the host by improving the survival animplantation of live microbial dietary supplementsin the gastrointestinal tract. Those effects are due toactivating the metabolism of one or a limited number ofhealth-promoting bacteria or by selectively stimulatingtheir growth, which improved the welfare of the host,or both (Gibson and Roberfroid, 1995).Lactobacilli and enterococci are among the wide varietyof microbial species that have been used extensivelyas probiotics (Patterson and Burkholder, 2003). Afterfeeding of probiotics, improvements in growth performanceand feed efficiency have been reported in broilerchickens (Kabir et al., 2004; Mountzouris et al.,2007; Samli et al., 2007). The proposed modes of actionof probiotics in poultry are as follows: 1) maintaininga beneficial microbial population by competitive exclusionand antagonism (Fuller, 1989), 2) improving feedintake and digestion (Nahanshon et al., 1992, 1993),and 3) altering bacterial metabolism (Cole et al., 1987;Jin et al., 1997). However, there is a dearth of informationregarding the effects of direct-fed microbials onthe histomorphology of the small intestine of broilerchickens.

MATERIALS AND METHODS

A total of 72 DOC of same hatch were randomly distributed into four groups i.e. T_0 (Control), treatment T_1, T_2 and T_3 with six sub groups comprising of three birds in each.

Table - 1 : Ingredient and nutrient composition of experimental diet (%DM)

Ingredients (%)	Broiler starter (0 - 21 days)	Broiler finisher (22 - 42 days)
Maize	60.00	63.00
Ground nut cake	23.11	18.00
Fish meal	13.00	15.00
Mineral mixture	3.00	3.00
Common salt	0.22	0.33
Vitaminpremix (vit. A,B2 ,D3)	0.02	0.02
TM - 100	0.10	0.05
Amprosol	0.05	0.05
Nuvimin	0.05	0.55
Nutrient composition		
Moisture (%)	6.29	6.22
Crude Protein (%)	23.29	21.28
Total Ash (%)	8.02	9.34
CP	22.00	19.00
ME (Kcal/Kg)	2900	3000

The control (T_0) groups were fed diet as per NRC (1994) standard (CP 22 and ME 2900) basal diet without any probiotic and other groups were fed the diets that consisted of 3 probiotic levels at initial concentrations of 1.0 × 106 cfu • g−1 (T_1), 2.0 × 106 cfu • g−1 (T_2), and 5.0 × 106 cfu • g−1 (T_3). The birds were randomly divided into 4 treatments (18 birds/treatments) and housed in pens of identical size in a deep litter system with a wood shaving floor. Each treatmenthad 3 replicates (6 birds/pen). The birds had free access to water and feed. The climatic conditions and lighting program were computer-operated and followed the commercial recommendations. Environmental temperature in the first week of life was 35°C and decreased to 25°C until the end of the experiment. During the first week, 22 h of light was provided with a reduction to 20 h afterward. Initial weight of each chick was recorded on arrival and then weekly. Initial weight of each chick was recorded on arrival and then weekly. The feed consumption was also recorded weekly to determine the feed conversion ratio. The experiment lasted for 35 days. Chicks were provided 0.8 sq.ft/bird space. Cages, feeders, waterers and other equipments were properly cleaned, disinfected and sterilized before use. The waterers were disinfected with 0.02% KMnO4 solution every day. Data obtained on various parameters were tabulated and statistically analyzed using analysis of variance (ANOVA) technique as per Snedecar&Cocharan (1994) in RBD

RESULTS AND DISCUSSION

In table 2 the initial weight, final weight, DWG, FCR, and survival rate of chickens given diets containing different probiotic. There was no significant difference in initial weight ($P > 0.05$) among treatments groups. The lowest final weight and DWG were found in control groups ($P < 0.05$) and there were no significant differences among probiotic treated groups. Lower FCR in T_2 (2.12±0.06) and T_3 (1.98±0.05) were observed than that of the control groups (3.07±0.07). However, there was no significant difference ($P < 0.05$) in FCR between T_1 and the other treatment groups. The groups that received the probiotic with a final concentration of 2.0 × 106 cfu • g−1 (T_2) and 5.0 × 106 cfu • g−1 (T_3) showed higher survival rate (97.65±1.7 % and 98.23±1.8%, respectively) than that in T_1 and control groups (93.35±1.3 % and 92.32±1.2 % respectively) and there was no significant difference between T_2 and T_3. No statistical differences ($P > 0.05$) were observed in survival rate between T_1 and the control.

Table - 2 : Daily weight gain (DWG), feed conversion ratio (FCR) and survival rate of broiler chicken treated with (T_1, T_2 and T_3) or without (T_0 control) probiotic.

Item	T_0	T_1	T_2	T_3
Initial weight (g)	43.35±0.7	44.27±0.8	43.76±0.6	44.37±0.8
Final weight (g)	1283±32.7	1289±29.7	1326±31.7	1332±42.7
DWG (g/d)	11.34±1.0	12.65±1.2	12.76±0.9	13.09±1.3
FCR	$3.07±0.07^{a}$	$2.85±0.04^{ab}$	$2.12±0.06^{b}$	$1.98±0.05^{b}$
Survival rate (%)	$92.32±1.2^{a}$	$93.35±1.3^{a}$	$97.65±1.7^{b}$	$98.23±1.8^{b}$

^{a,b}Means in the same row with different superscripts are significantly different ($P < 0.05$).

1T-1, T-2, and T-3 were fed with diets containing different concentrations of viable *Bacillus sp.* (with a final concentration of 1 × 106 cfu • g−1, 2 × 106 cfu • g−1, and 5 × 106 cfu • g −1, respectively). Results are presented as mean SE

The effect of probioticon broiler chicken growth performance was evaluated in this study. It was clear that the administration of probiotic via the basal diet had beneficial effects on final weight and DWG. The previous studies showed that supplementation of the adherent *Lactobacillus* cultures to chickens, either as a single strain of *Lactobacillusacidophilus* or as a mixture of 12 *Lactobacillus* strains, increased significantly ($P <$ 0.05) the BW of broilers after 40 d of feeding (Jin et al., 2000). Similar findings were obtained in other reports (Timmerman et al., 2006) and showed that the probiotic strains promoted the growth performance of birds. On the contrary, (Kumprechtova et al.,2000) investigated the effect of probiotic, *S. cerevisiae*, on chicken broiler performance and showed that the bacteria strains could not improve the live weight at 21 and 42 d of age. No positive effect on the growth performance of chickens was also found in another study (Priyankarage et al., 2003). However, it was difficult to directly assess different studies using probiotics because the efficacy of a probiotic application depended on many factors (Patterson and Burkholder, 2003) such as species composition and viability, administration level, application method, frequency of application, overall diet, bird age, overall farm hygiene, and environmental stress factors.In addition, there was no significant difference among the treatment groups (T_1, T_2, and T_3) with different concentrations of probiotic bacteria. This indicated that the quantity of *Bacillus sp.* was only one of the factors improving final weight and DWG of the local chickens in China. Findings of this study showed that the use of the probiotic *B. coagulans*at a certain concentration (2.0 × 106 cfug−1 and 5.0 × 106 cfu • g−1) in diet could significantly reduce FCR of broiler chickens. Similarimprovements in feed efficiency had been reported forpoultry receiving probiotic *Lactobacillus* strains (Mohanet al., 1996; Lan et al., 2003). The work investigatingthe efficacy of a new multibacterial species probioticcontaining *Lactobacillus*, *Bifidobacterium*, *Enterococcus*,and *Pediococcus*strains in male Cobb broilers hadshown inconsistent results (Mountzouris et al., 2007).In contrast, there was no significant difference in FCRbetween probiotic treatments and the control. It couldbe associated with the different species of birds andprobiotic.The *Lactobacillus* strains that were isolated from freshdigesta and intestinal tissue samples of healthy chickenshad improved the survival rates of broilers in controlledtrials by the addition of probiotics to the drinking water(Timmerman et al., 2006). A similar result was alsoobserved by Vicente et al. (2007) with *Lactobacillus*spp.-based probiotic in broiler chicks. In the presentresearch, a higher survival rate was observed in T_2 andT_3compared with T_1 and the control. It coincidedwith the result of FCR and growth performance.

CONCLUSION

It was concluded from this study that the probiotic (*Lactobacillus* sp.) on the growth performance of broiler chicken. The lowest final weight and daily weight gain were found in control groups ($P < 0.05$) and there were no significant differences among probiotic-treated groups. Significantly lower feed conversion ratio and higher survival rate were observed in T_2 and T_3 than that of the control. From economic point of view feed containing 2.0 × 106 cfu • g−1 (T_2), and 5.0 × 106 cfu g−1 (T_3) the probiotic (*Lactobacillus* sp.)was better

due to significantly lowest feed conversion ratio.

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