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THE SCIENCE OF GOAT MILK AND ITS PRODUCTS

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ABSTRACT

Research in the past few decades has extended knowledge of composition of goat milk and of properties of its constituents. Goats of several European breeds produce milk of lower fat content in the tropics than in temperate zones. Fat, protein, and lactose contents of milk of dwarf goats are higher than those of other breeds. Fat globules of goat milk resemble those of cow milk in lipid composition and properties of the globule membrane, but goat milk lacks "agglutinin" which causes fat globules of cow milk to cluster when cooled. Five principal proteins of goat milk, α-lactalbumin, β-lactoglobulin, κ-casein, β-casein, and αs2-casein, closely resemble their homologs in cow milk. Goat milk lacks a homolog of bovine βs1-casein, the most abundant protein in cow milk. Caseinate micelles of goat milk contain more calcium and inorganic phosphorus, are less solvated and less heat stable, and lose β-casein more readily than bovine micelles. Activities of ribonuclease, lipase, and xanthine oxidase are less in goat than in cow milk. Goat milk contains more potassium and chloride but less orotic acid, N-acetyl neuraminic acid, folate, vitamin B6, and vitamin B12 than cow milk. Little work in the past decade has been on nutritive value of goat milk for humans except to describe cases of folate deficiency in infants.

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INTRODUCTION

Milk is considered as nearly complete human food and considered as the first food for the newly born off-spring. Goats (*Capra aegagrushircus*) were the first species to be domesticated as livestock about 8000 BC in Mesopotamia, part of today's Middle East. Goat milk production in India increased from 3.6 to 4.7 million tons during the year 2015-16 with an annual growth rate of 2.6%. The country stands first in goat milk production in the world by sharing 29%(CIRG, 2015-2016). Different varieties of cheese, yoghurt, ice cream, fluid milk and milk powder are produced from goat milk. Goat milk has traditionally been known for its medicinal properties and has recently gained importance in human health due to easy digestibility and it's all round health promoting traits. Goat milk has advantages over cow or human milk in having higher digestibility of protein and fat, alkalinity, buffering capacity, and certain therapeutic values in medicine and human nutrition. Due to lack of availability of cow milk, goat milk and its products provide important daily food sources of protein, phosphate and calcium in

developing countries. Goat milk is considered as "self-homogenized" milk.

CHEMICAL COMPOSITIONS OF GOAT MILK

Composition of goat milk are vary according to changes in diet, individuals, season, breed, species, feeding managements, environmental conditions, stage of the lactation, locality and condition of the udder. Goat milk is similar to cow milk in its basic composition. Caprine milk contains 12.2% total solids, 3.8% fat, 3.5% protein, 4.1% lactose, and 0.8% ash. It has more fat, protein, and ash and less lactose than cow milk. Goat milk contains slightly less total casein, but higher non-protein nitrogen than the cow counterpart. Goat milk and cow milk have 3 to 4 times greater levels of protein and ash than human milk. Total solids and caloric values of goat, cow, and human milks are similar (Jenness, 1980; Chandan*et al*., 1992).Goat milk differs from cow milk in having better digestibility, buffer capacity, alkalinity and therapeutic values. Fat of goat milk have higher physical properties i.e. surface tension, viscosity and specific gravity as compared to cow milk (Park *et al.*, 2007).

Table - 1: Average composition of milk from goat, cow, buffalo and human

Component (Per cent)	Goat	Cow	Buffalo	Human
Water	87.5	87.7	83.2	86.7
Protein	3.4	3.2	4.5	1.2
Fat	3.8	3.6	6.7	4.0
Solid-not-fat	8.9	9.0	10.1	8.9
Lactose	4.1	4.7	4.5	6.9
Casein	2.4	2.6	-	0.4
Total ash	0.8	0.7	0.8	0.3

(Source: Park *et al.,* 2007

Milk Lipid

Major differences between goat and cow milk is physicochemical structure and composition of milk fats. The fat globules range between 1 and 10 µm in both goat and cow milk (Silanikove*et al.,* 2010).In respect to free lipids, goat milk has higher values than that of cow milk. Goat milk contains 97–99% of free lipids and 1–3% bound lipids of total milk fat (Cerbulis*et al.*, 1982). Goat milk contained 96.8% triglycerides, 2.2% diglycerides and 0.9% monoglycerides. Goat milk is rich in short- and medium-chain fatty acids (FAs) compared to the cow milk (Luke and Keith, 1992; Silanikove*et al.,* 2010; Amigo and Fontecha, 2011).

Table - 2 : Fatty acid composition (Per cent of total fatty acids) of goat milk (n=30) from Granadina goats and cow milk (n=30)

Fatty Acids	Goat milk	Cow Milk
Butyric acid	1.27	3.84
Caproic acid	3.28	2.28
Caprylic acid	3.68	1.69
Capric acid	11.07	3.36
Lauric acid	4.45	3.83
Myristic acid	9.92	11.24
Palmitic acid	25.64	32.24
Stearic acid	9.92	11.06
Oleic acid	23.8	21.72
Linoleic acid	2.72	2.41
CLA tot	0.68	0.4
α-linolenic acid	0.53	0.25
PUFA n-6	2.81	2.53
PUFA n-3	0.51	0.25
PUFA tot	4.08	10.49

(**Source :** Ceballos*et al.,* 2009)

The short-chain FAs represent 15-18%. The short- and medium-chain FAs are partly responsible for the characteristic "goaty" odor (Silanikove*et al.,* 2010; Amigo and Fontecha, 2011).The medium-chain triglycerides were found to be 30.83% and 25.16% in goat and cow milk, respectively, whereas the long-chain triglyceride were 53.95% and 64.01% in the same order (Ruiz-Sala *et al*., 1996).

Cholesterol contents of goat, cow and human milk were reported as 11, 14, and 14 mg/100 g milk, respectively (Posati and Orr, 1976). Goat milk consists more of the linoleic and arachidonic acids and CLAs (Luke and Keith, 1992; Amigo and Fontecha, 2011). Total CLA content of goat milk is 35.75 mg/100 g while it is only 15.62 mg/100 g in cow milk (Ceballos *et al*., 2009).

Amino acids and Protein

The amounts of free amino acids are different between goat and cow milk. The higher content of cysteine (derived from cystine) has been shown to improve intestinal absorption of copper and iron in a rat model of malabsorption syndrome (Barrionuevoet al. 2002; Haenlein, 2004).

Table - 3 : Average amino acid composition (g/l00 g milk) in proteins of goat and cow milk

Amino acids	Goat milk	Cow milk	Difference (per cent) for Goat milk
Essential amino acids			
Tryptophan	0.044	0.046	
Threonine	0.163	0.149	+9
Isoleucine	0.207	0.199	+4
Leucine	0.314	0.322	
Lysine	0.290	0.261	+11
Methionine	0.080	0.083	
Cystine	0.046	0.030	+53
Phenylalanine	0.155	0.159	
Tyrosine	0.179	0.159	+13
Valine	0.240	0.220	+9
Non-essential amino acids			
Arginine	0.119	0.119	
Histidine	0.089	0.089	
Alanine	0.118	0.113	
Aspartic acid	0.210	0.250	
Glutamic acid	0.626	0.689	
Glycine	0.050	0.070	
Proline	0.368	0.319	
Serine	0.181	0.179	

(Source: Posati and Orr, 1976)

Taurine is the most representative free amino acid in goat milk and the concentration is much higher than in cow milk (Huxtable, 1992;Sarwar*et al.,* 1998; Tripaldi*et al.,* 1998; BelewuandAiyegbusi, 2009). There are two distinct phases of milk proteins; micellar phase composed of casein and a soluble composed of whey proteins. The caseins constitute about 80% of the proteins and are classified as αs_1, αs_2, β and κ-caseins, while the major whey proteins are β-lactoglubulin and α-lactalbumin (Slacanac*et al.,* 2010). Goat milk contains lower amounts of the αs-casein, higher amounts of the β-casein fractions and equal amounts of the κ-casein fractions compared to cow milk (Park *et al.,* 2007). The casein micelles in goat milk differ from those in cow milk in having greater β-casein, more calcium & phosphorus and lower heat stability (Jenness, 1980). Two types of β-lactoglobulin have been identified in goat milk and three variants of α- lactalbumin (Moatsou*et al.,* 2005).

Lactose

Lactose is a major carbohydrate present in goat milk but content slightly low as compared to cow milk (Slacanac*et al.,* 2010). Other carbohydrates found in goat milk are oligosaccharides, glycopeptides, glycoproteins and nucleotides in small amounts. Goat milk is significantly rich in lactose-derived oligosaccharides compared to cow milk (Slacanac*et al.,* 2010). Milk oligosaccharides are thought to be beneficial to human nutrition because of their prebiotic and anti-infective properties (Kunz *et al.,* 2000).

Mineral and Vitamins

Goat milk is reported to have higher content of potassium, calcium, chloride, phosphorus, selenium, zinc and copper than cow milk (Slacanac*et al*., 2010).Goat milk has a higher vitamin A content than cow milk because goats convert all β-carotene from foods into vitamin A (Geissler and Powers, 2011).

Table - 4 : Proximate vitamins (per 100 g) content in milk of various species

Component	Goat milk	Cow milk	Buffalo milk	Human milk
Vitamin A (IU)	185	126	177	190
Vitamin D (IU)	2.3	2.0	-	1.4
Thiamin (mg)	0.07	10.05	0.04	0.02
Riboflavin (mg)	0.21	0.16	0.13	0.02
Pantothenic acid (mg)	0.31	0.32	0.20	0.20
Niacin (mg)	0.27	0.08	0.09	0.17
Vitamin B_6 (mg)	0.05	0.04	0.02	0.01
Folic acid (µg)	1.0	5.0	3.3	5.5
Vitamin B_{12} (µg)	0.07	0.36	0.14	0.03
Biotin (µg)	1.5	2.0	-	0.40
Vitamin C (mg)	1.29	0.94	1.00	5.00
Energy (kcal/100 ml)	70.0	69.0	117.0	68.0

(Source: Park *et al.,* 2007**)**

Both goat and cow milk have low concentrations of vitamin B6 and vitamin D, which are both important during infancy (Park *et al*., 2007). Goat milk is deficient in folic acid and vitamin B12, which cause 'goat milk anemia' (Jenness, 1980; Park *et al.* 2007). Vitamin C is a well-known water-soluble antioxidant that is found in greater amounts in goat milk than in cow milk (Geissler and Powers, 2011).

Table - 5 : Proximate minerals (g/100 g) content in milk of various species

Component	Goat milk	Cow milk	Buffalo milk	Human milk
Sodium	41	44	35	15
Potassium	181	152	92	55
Calcium	134	122	112	33
Magnesium	16	12	8	4
Phosphorus	121	119	99	43
Sulphur	28	32	-	14
Iron	0.07	0.08	0.16	0.20
Chloride	150	100	-	60
Se (µg)	1.33	0.96	-	1.52
Copper (mg)	0.05	0.06	0.04	0.06
Manganese (mg)	0.03	0.02	0.02	0.07
Zinc (mg)	0.56	0.53	0.41	0.38
Iodine (mg)	0.02	0.02	-	0.01

(Source: Park *et al.,* 2007**)**

NUTRITIONAL AND THERAPEUTIC VALUES OF GOAT MILK

Digestibility and Micronutrient absorption

The most appearing property of goat milk is superior digestibility and absorption of micronutrients. Digestibility of goat milk is highly enhanced by nature of the proteins and the fat molecules (Park *et al.,* 2007). Goat milk does not contain the protein agglutinin that promotes clustering of fat globules. The absence of clustering facilitates rapid digestion and absorption (Farah, 1991).

Antimicrobial activity

Goat milk contains high levels of medium chain fatty acids, such as caprylic and capric acids. These fatty acids are highly antimicrobial. Capric and caprylic acids are used in dietary supplements to inhibit the growth of *Candida albicans*and other yeast species (Mwenze, 2015).

Alkalinizes the blood and the intestine

Goat milk helps to increase the pH of the blood stream. It is the only dairy product with the highest amount of the L-glutamine. Acidic blood and low intestinal pH levels have been associated with fatigue, headaches, muscle aches and blood sugar imbalances (Mwenze, 2015).

Less allergenic and brain development

In the USA and Canada the department of pediatrics has recommended that cow's milk be avoided for children between 0-6 months due incidences of allergy (Playford*et al.* 2000).Sialic acid profile of goat colostrums milk is similar to human milk (Kumar*et al.,* 2016) and helps in brain development.

Dengue fever

Dengue fever is mainly transmitted to humans by *Aedesaegypti*mosquito. So, for treating this disease goat milk and milk products are mostly preferred. Deficiency of selenium and decrease in platelet count are the main complications of dengue

fever. Goat milk as well as its products is richest source of selenium (Kumar *et al.,* 2016).

Growth factors for infants

Goat milk contains high levels of growth factors similar to those found in human milk making it an essential diet for the infants. The Transforming Growth Factors (TGF) has a physiological role in maintaining regular functionality of the infant (Playford*et al*., 2000).

Prevention of inflammatory bowel disease

Oligosaccharides from goat milk are shown to have an anti-inflammatory effect. The expected decrease in body weight, increased colon size and extension of necrotic lesions are prevented by the oligosaccharides (Lara Villosladaet *al*., 2006).

Cardiovascular diseases (CVD)

Goat milk is rich in medium chain triglycerides (MCT) including caproic, caprylic and capric acids. These MCT have a lowering effect on plasma cholesterol in rat models and act as anti-atherogenic(Davenport, 2002).

Prevention of milk allergy

The proteins αs_1 casein and β-lactoglobulinare important allergens in cow milk allergy. Since the content of αs_1casein is very high in cow milk but relatively low in goat milk, the latter has been suggested as an alternative milk source for cow milk allergies (Tomotake*et al*., 2006).

Immunomodulatory activity and immunity booster

Jirillo*et al*. (2010) showed immune modulatory effects from goat milk both in *in vitro* and human studies. The effects of goat milk on human blood cells in terms of nitric oxide (NO) and cytokine release. The results demonstrated that goat milk was able to activate NO release from blood cells as well as triggering of cytokine production. Selenium is one of the key component for the immune system functionality.

Anti-carcinogenic effect

Goat milk has a high content of conjugated linoleic acid (CLA) (Jirillo*et al*., 2010). Anti-carcinogenic properties of CLA have been reported against mammary and colon cancer in animal models, as well as in vitro models of human melanoma, colorectal and breast cancer (Palombo*et al*., 2002).

Effect on infancy intake

Basnet *et al*. (2010) reported an infant was exclusively fed goat milk, which led to azotemia (abnormally high levels of nitrogen compounds in the blood), hypernatremia (electrolyte imbalance caused by elevated sodium levels) and hemorrhages in the brain but when it gave malnourished children (1-5 years) goat or cow milk, weight gain and fat absorption were similar in both groups.

Therapeutic value of goat milk

Kullisaar*et al*. (2003) showed antioxidative and anti-atherogenic effects from fermented goat milk. Minervini*et al*. (2009) developed fermented goat milk with a mixed starter culture which resulted in production of GABA and provoked an in vitro ACE-inhibitory activity, which counteract high blood pressure. Sanna*et al*. 2(005) used a mix of *Streptococcus thermophilus*and*Lactobacillus delbrueckii*subsp. *bulgaricus*when fermenting goat milk which resulted in to a yogurt with a significant quantity of folate and good sensory attributes. IgA account for the majority of serum immunoglobulins.

MILK PRODUCTS

Various goat milk products, including fluid, fermented, frozen, condensed, and dehydrated milk products, are produced in many countries. Goat milk products especially cheeses and yogurt are very popular in the Mediterranean peninsula, the Middle East, Southern Russia and the Indian subcontinent (Yangilar, 2013)

Liquid Milk Products

Goat milk is white in colour and has a

stronger flavour (Agnihotri and Prasad, 1993). Ahmed *et al.* (1992) used fruit Guava, Orange and Fig for fortifying skim goat milk in order to prepare low fat beverages. Pruksasri and Supee (2013) assessed the feasibility of producing goat milk containing galactooligosaccharides (GOS) by treating milk with the enzyme β-galactosidase. Milk contains GOS had higher overall acceptability compare to regular milk.

Butter and ghee

Rodriguez *et al*. (2003) optimized processing parameters for manufacture of butter from cultured cream. This cultured formulation achieved optimal sensory quality in appearance, flavour, texture, and overall quality. Bindal and Wadhwa (1993) demonstrated that goat ghee has a higher liquid fraction (69%) compared with cow ghee (30.5%) or buffaloe ghee (36%). Levels of glycerides were also higher in ghee prepared from goat milk as compared to cow and buffalo milks.The melting point and softening point of ghee prepared from goat milk were also low.

Milk Powder

The freeze, roller and spray drying techniques were used in manufacture of milk powder from goat milk (Pandya and Ghodke, 2007). Reddy *et al.* (2014) optimized the processing conditions for manufacture of spray dried from goat milk. A mixed fruit flavour was added to the concentrated milk to avoid the goatyflavour in the final powder. The mean values of proximate composition of spray dried powder viz., moisture content, fat, protein, carbohydrates, ash and titrarable acidity were 4.08%, 26.85%, 25.48%, 36.99%, 6.60% and 0.14%, respectively.

Yoghurt and Fermented Milk Products

Fermented goat milk incorporating live probiotic cells have good nutritive and therapeutic properties (Slacanac*et al.,* 2010).A mixed starter has been successfully used for fermentation of goats milk (Yangilar, 2013). Beyond all nutritive features of goat milk, one of the major disadvantages is non-existent of folic acid content. This disadvantage could be solved by using folate producing bacteria during fermentation by use in *Streptococcus thermophilus*and*Lactobacillus delbrueckii subsp. bulgaricus*in goat milk results in yoghurt with significant quantity of folate and good sensory features (Sanna*et al.,* 2005).Ehirim and Onyeneke (2013) made yoghurt with cows and with goat milk. Patel and Roy (2016) compared the quality of yoghurt using instrument texture analyser. Paz *et al.* (2014) showed the technological potential and adequacy of using goat milk to produce potentially symbiotic yogurt. Bano*et al.* (2011) concluded that mixing 75% goat milk and 25% sheep milk in manufacture of yoghurt improved color, flavour and texture scores of the resultant yoghurt. Damunupola*et al*. (2014) suggested that the incorporation of beetroot extract could mask the goaty-flavor and goaty-odor of the yogurt made from goat milk. Gursel*et al*. (2016) made yoghurt with the fortification of 2% (w/v) each of skim goat milk powder, sodium caseinate, whey protein concentrate, whey protein isolate, or yogurt texture improver. Labneh is a delicious popular cultured dairy product which produced from yoghurt coagulates (Abbas *et al.,* 1999). Goat labneh is higher in ash, but fat and protein contents were the same as cow labneh (Rao*et al.,* 1987). Mehaia (2005) studied the chemical composition and sensory evaluation of fresh labneh made from goat milk, using ultrafiltration (UF) and traditional processes.

Cheese

Goat milk cheese was originated in Mesopotamia (Yangilar, 2013). A piquant and peppery sharp flavor observed in ripened goat milk cheese due to presence of greater proportion of short & medium chain fatty acids in goat milk (Tziboula-

clarke, 2003). There are three categories of cheese which produced from goat milkviz traditional cheeses made at home, cheeses produced on farm scale and cheese made from mixed sheep and goat milks (Kalantzopoulos, 1993; Walstra*et al*., 2006).Loewenstein*et al*., (1980) and Park and Guo (2006a, b) described goat milk whey cheese, the process where caramelized lactose in concentrated whey is combined with fat and whey proteins to make Gjetost cheese. Mehaia (2002) made fresh soft white cheese (Domiati-type) from goat milk using ultrafiltration (UF) and conventional processes. El-Sheikh *et al.* (2011) successfully made blue cheese from goat milk. Attulla*et al.* (2014) fortified goat cheese with caramel, cocoa and cocoa with walnuts are corresponding high quality protein ingredient for sweet spreadable cheese and concluded that fortified sweet goat cheese with cocoa and walnut could be regards as Egyptian economic products and nourished for human consumption especially for children feeding.

Ice cream and Frozen Desserts

Silva *et al.* (2016) manufactured ice cream enriched with different amounts of carob powder. They reported that goat milk ice cream containing carob powder which was added @ 12% was found to be most acceptable with respect to all sensory attributes. Ranadheera*et al.* (2013) developed chocolate flavored probiotic ice cream made from goat milk using a probiotic bacterial culture. Konar and Akin (1997) and Pandya and Ghodke (2007) compared the chemical, physical and organoleptic qualities of ice cream made from cow, goat and sheep milk for their suitability for ice cream production. Goat milk produced the most acceptable ice cream followed by cow milk. Goat milk frozen yogurt was prepared using caja (*Spondias-mombim*L.) flavour. The sensory acceptance test indicated that formulations containing 20% and 30% caja pulp were the most accepted (Keily*et al.,* 2016).

Other Traditional Indian Dairy Products

Several Indian traditional products such as ghee, chakka, shrikhand, paneer, channa, etc. can be made from the goat milk (Ribeiro and Ribeiro, 2010; Yangilar, 2013; Pal, 2014). Joshi *et al.* (1991) made chhana from goat milk and have soft body and smooth texture. Bhargava *et al.* (1992) investigated influence of fat percentage on the yields and qualities of chhana and rasogolla from goat milk. Sharma *et al.* (1995) investigated the method of chhana making from Jamunapari and Barbari goat milk using different level of coagulant.Vijiet *al.* (2017) prepared paneer by the admixture of goat and buffalo milk at different proportion. Agnihotri and Pal (1996) standardize the method of shrikhand production. Bhat *et al.* (2016) made a novel goat milk bar usingrose flower extracts and natural sweeteners. Singh *et al.* (2018) made goat milk shrikhand blended with sapota pulp and betel leaf extract. Ramlingam*et al*.(2009) prepared dahi utilizing goat milk

Application in Cosmetics

High volume of cosmetic products are produced from goat milk, including soaps, creams, body lotions, shampoos, hair conditioners, after shave lotions, which are marketed in many countries such as US and Switzerland (Ribeiro *et al.,* 2007). Goat milk contains capric and caprylic acids which enhance permeability in skin, used as a carrier of other chemical compounds in lotions and creams (Wongpayapkul*et al.,* 2006).

LIMITATIONS OF GOAT MILK

Goat milk contains virtually no folic acid. To be adequate as an infant formula it has to be fortified (Mwenze, 2015).

Goat milk is an apocrine secretion. Apocrine is a type of glandular secretion where the secreting cell is released along with the milk. The milk has high levels of somatic cell counts which are

not desirable (Mwenze, 2015).

CONCLUSION

Goat milk and its product is a rich source of more bioavailable proteins, fats, vitamins and minerals with great suitability for infant foods. Due to its high nutritive value and physiological properties, goat milk should be promoted in the developing countries like India, where malnutrition and diseases are more prevalent along with high poverty levels. The maintenance cost, general management and feeding of dairy goat is very low. But commercialization and utilization of goat milk is still lacking in developing countries. And scientific community has lack of information related to its use for commercialization. This area needs more research to do.

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MICRONUTRIENT INDUCED MODIFICATION IN PANCREAS OF HYPERGLYCEMIC ALBINO RATS

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ABSTRACT

Around 285 million individuals worldwide were projected to have diabetes as of 2010, with type 2 diabetes accounting for roughly 90% of occurrences. Its prevalence is quickly rising, and by 2030, this number is predicted to nearly double. All across the world, there are cases of diabetes mellitus, however type 2 is more prevalent there than in less developed nations. Since the development of insulin in 1921, all types of diabetes can be managed with medicine, even type 2 diabetes. Hypoglycemia can be brought on by oral medicines and insulin (low blood sugars). Types 1 and 2 are both chronic diseases that have no treatment options. A necessary metal called chromium appears to be helpful in controlling insulin activity, metabolic syndrome, and cardiovascular disease. Without chromium, the insulin hormone would not operate properly in human bodies.

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INTRODUCTION

The duration of this should not exceed three months. (2009) Diabetes Spectrum It is generally known that zinc ions play a key role in the control of many cellular functions, making it a necessary dietary supplement for humans. Zinc's insulin-like activities and probable connection to insulin resistance and type 2 diabetes are among its noteworthy in vivo properties.

Additionally, the zinc ion functions as the fundamental supporter in the structure of insulin microcrystals and delays the transition of insulin crystals from polymers (often hexamers) to monomers that can be absorbed by the body. Zinc is known to create zinc-containing hexamers, which are known to increase the stability of the insulin crystal structure.

The activity of insulin, as well as the metabolism of carbohydrates, depend heavily on zinc. Hyperglycemia is the primary characteristic of type 2 diabetes mellitus, which is brought on by decreased insulin production and increased insulin resistance. Numerous studies have demonstrated that diabetes alters zinc metabolism. The often

observed insufficient effectiveness of oral hypoglycemic drugs may be ascribed to insufficient post receptor events linked to oxidative damage brought on by prolonged hyperglycemia.

Selenium is a universal essential trace element for mammals which is important for many cellular processes. In the first half of the 20th century, selenium, due to its toxicity was considered an undesirable element for higher organisms. A new biological perspective of se was shown by the pioneering work of Schwarz and flats (1957) who reported that selenium at very low dietary concentrations is an essential nutrient.

Selenium is generally efficiently absorbed through diet, and if it is in an organic form, it works even better since selenoproteins, which contain selecnocysteins, operate as antioxidants. The best-known glutathione peroxidases, thio-redoxi-reductases, and iodo-thyronine-deiodonases are among the approximately ten distinct selenoproteins that are described. Additionally, selenoproteins are in charge of delivering such to tissues. While severe selenium shortage is uncommon, diabetics have lower amounts of selenium as well as higher levels of oxidative stress. Selenium levels below 80 ug/l are associated with insulin resistance and CRP in the offspring of diabetic patients.

Chromium deficiency can cause hypoglycemia or the onset of diabetes. Supplemental chromium can improve insulin sensitivity, lower fasting blood glucose, and boost natural insulin production even in healthy individuals. Chromium therapy for type 2 diabetes has improved haemoglobin, insulin, and serum glucose levels. Organic chromium complexes produce better outcomes than inorganic chromium, and type 1 diabetes patients' glucose control also improves. Chromium supplementation lowers gestational diabetes insulin resistance in a dose-dependent way. When glucocorticoids are used therapeutically, diabetes can be reversed with chromium. Chromium affects blood glucose homeostasis by causing an increase in insulin receptor activation. In a dose-dependent manner, chromium can lower high triglycerides and cholesterol levels.Triglyceride reduction may take a longer time higher dose in diabetes.

Supplementing with se in such diseases seems desirable in light of the so's strong anti-inflammatory and antioxidant properties as well as the major role played by these disorders in insulin resistance and diabetes.

Historical Review

Hypoglycemic effect of Zinc:

In an experiment, Garget et al. (1994) discovered that diabetics' serum zinc levels were considerably lower than those of healthy controls. Oral zinc may be useful in treatment for hypozincemia in diabetes mellitus, which may be caused by altered zinc metabolism.

Recently, it was discovered that both the Zn (II) ion and many Zn (II) complexes displayed high insulin mimetic activity in in-vitro and in-vivo experiments when combined with nicotinamide, maltol, amine acids, nicotinic acid, pecolinamide, metal, and their derivatives. These complexes were successful in demonstrating how daily intraperitoneal injections of glucose to people with type 2 diabetes mellitus might lower blood glucose levels (Yutaka yoshikawa et al., 2003).

Zn deficiency activates stress pathways and may result in a loss of tyrosine phosphates control thereby causing insulin resistance (Haouse*et al*., 2005).

Both diabetes model animals and chuman diabetic patients' glucose consumption was enhanced by the complexes of these metals and tiny chemical molecules (ligands) (Sakuai et al., 2006; Thompson et al., 2006).

Hypoglycemic effect of selenium:

The correlation between dietary selenium intake and selenium biomarkers has been inconsistent across studies, ranging from positive, strong associations (Duffield A.J. et al. 1999,) to weak or null association (Hunter D.J. et al. 1990; Sotia J.A. et al. 2006).

It is evident from the text that Se has multiple roles in biological systems. A number of reviews have recently been written on the chemopreventive effects of Se. (Rayman, 2000, El-bayoumy 2001, E.l.Bayoumy and Sinha 2004, 2005; Whanger, 2004; Combs, 2005).

It has been reported that oxidative stress reduces insulin secretion and increases insulin resistance in some experimental models and may thus play a causal role in the pathogenesis of diabetes. (West, 2000; Stumvoll et al., 2005; Evans et al., 2005).

Many diabetic complications are thought to be caused by oxidative damage and decreased antioxidant protection. Studies have shown that selenium can protect against oxidative damage attributable to unregulated blood sugar. (Naziroglu M. 2001 and Guney M. et al 2011).

Xi-Qun sheng et. al. (2004) on the basis of other experiments demonstrated that although oral administration of a high dose of selenite had no hypoglycemic effect on the diabetic mice.

Andreasn S. Mueller and Josef Pallauf (2006) performed experiments on db/db mice to investigate the antidiabetic mechanisms of selenate in type II diabetic animals.There is little epidemiological evidence on the association of selenium with diabetes among European populations (Gzernichow S. et al. 2006; Akbaraly T.N. et al. 2010).

Selenium, an essential trace element, is involved in the complex system of defense against oxidative stress through selenium dependent glutathione peroxidases and other selenoproteins (Burt, 2007) .

A cross sectional study in almost 9000 American adults as well as another analysis reported a positive link between high selenium levels and diabetes. (Bleys J. et al. 2007 and Laclaustra M. et al. 2009).Kornhauser C. et al. 2008 demonstrated selenium protection against diabetes. One study showed that non-diabetic individuals had higher serum selenium concentration compared to the diabetic individuals.

Xi-Qun Sheng and Coworkers demonstrated that although oral administration of a high dose of selenite had no hypoglycemic effect on diabetic mice in 4 week, selenite treatment still maintained the antioxidant beneficial effect on the diabetic mice.

Selenium may change the way that hepatocytes secrete, favouring the pro-inflammatory condition connected to diabetes. However, animal and case control studies (Navarro-Alarcon M. et al. 1999; Kljai K. et al. 2001; Rajpathak S. et al. 2005) suggest selenium may improve glucose metabolism (Douillet C. et al. 1996; Hwang D. et al. 2007; Lizuka, Y. et al. 2010; Ghaffari T. et al 2012). By reducing oxidative stress, experimental findings indicate that antioxidant dietary supplements, such as selenium, may prevent the onset of type 2 diabetes. 2009 Steinbrenner, H. According to Yang Z. et al. (2010), excessive se causes oxidative damage, inflammation, and disorders such juvenile idiopathic scoliosis.

Selenium (Se), an antioxidant element, was examined in individuals with type 2 diabetes mellitus' serum by O. Akinloye et al. in 2010. When compared to the control group, the serum selenium levels in diabetes individuals was considerably lower.

Selenium is generally well absorbed from food; this is especially true of organic forms. In the

form of selenocysteine-containing selenoproteins, it functions as an antioxidant. In diabetics, there are lower levels of selenium and higher levels of oxidative stress. (Wiensperger, Nicolas, and Rapin, Jean Robert 2010) Although glucose by itself might cause oxidative stress, Vassort G. and B. Turan (2010) hypothesised that selenium deficiency in diabetic rats may make the condition worse.

Dietary selenium and its enzyme levels completely determine how the body responds to oxidative stress (Rayman, 2010). The prospective relationship between dietary selenium intake and risk of type 2 diabetes was studied by Saverio Stranges et al. in 2010. In a group of Italian women, higher dietary selenium intake was linked to a higher risk of type 2 diabetes. In 2011, Usha Joshi and colleagues examined the link between low serum selenium levels and diabetes. Selenium levels in diabetic individuals had dramatically dropped, according to MojtabaBeheshtiTabar (2012). According to other research, diabetic patients' serum selenium levels either rose, fell, or stayed the same in comparison to controls. (Uyoyo et al. 2010, Reddi et al. 2001)

The epidemiological studies most likely reflect oxidative stress brought on by a lack of selenium or an excess of it in the body. These findings are very helpful in understanding diabetes and other chronic diseases because they support the idea that there is an ideal physciological oxidant tone that is necessary for negative associations between selenium and diabetes may be a direct observation of selenium excess or deprivation disrupting intracellular H2O2 signalling (Samaylenko A. et al. 2013; Bindoli A. and Rigobello M.P. 2013). (Rhee S.G. 1999). It is crucial to do research into how selenium affects personal health care since it may shed light on why the element plays a double-edged role in the pathophysiology of chronic diseases.

Hypoglycemic effect of chromium:

An vital nutrient for both humans and animals is chromium (Cr) (Mertz, 1993). Because chromium tripicolinate was found to decrease the proportion of insulin that porcine hepatic plasma membranes bound to the substance, chromium may have an impact on the hepatic extraction of insulin from portal blood.

When dietary lysine levels were increased from 80 to 120 percent of the NRC recommended lysine requirement in uncrowded pigs, dietary chromiumtripicolinate appears to have amplified the rise in baseline plasma insulin concentration (Ward et al., 1997).

To stimulate glucose absorption into skeletal muscle and adipose tissue, this in turn causes the translocation of glucose transporter-4 from an intracellular vesicular compartment to the plasma membrane (Czech and Corvera, 1999).

According to Striffler et al. (1998), rats fed a high-fat, low-chromium diet showed better insulin resistance. Chromium (33 ug/kg) reduces insulin resistance in rats fed a high-fat, low-chromium diet (Stiffler et al. 1998).

Investigations on the possibility of chromium supplementation in insulin resistance and diabetes have quickly been sparked by the advent of glucose intolerance or even fasting hyperglycemia in cases of proven chromium deficiency. Furthermore, numerous biological samples from diabetic patients have roughly 1/3 less chromium. (Kozie et al., 2008; Marris et al., 1999).

The effects of combined zinc (Zn) and chromium supplementation on oxidative stress and glucose homeostasis in type 2 diabetics were investigated by Anderson et al. in 2000.

Under hyperglycemic conditions, it also reduced oxidative stress, glycosylation, and lipid peroxidation in erythrocytes and monocytes. (Yand X. et al., 2006; Dogukan A. 2010; Jain S.K. 2001).

The same is true when certain trace elements, including chromium or zinc, are linked to oral diabetes medications. (Wierensperger, Nicolas, and Rapin, Jean Robert 2010).

MATERIALS AND METHODS

Experimental animal:

The male albino rat, *Rattusnorvegicus* has been selected for the present study. The albino rats were obtained from Zamia Hamdard University and AIIMS, New Delhi (India).

Maintenance and feeding of experimental animal:

Healthy albino rats were housed in 45 x 27 x 15 cm polypropylene cages at a temperature of 25 0.5 °C and an 8-hour photoperiod every day. The rats were practically identical in size and weight, weighing between 150 and 200 gm 10 gm. Prior to the trial, the rats had a three-week acclimation period. Mesh composed of galvanised steel was used for the cages' tops. Water was available ad libitum, and the rats were fed on regular rat and mouse food.

Induction of Diabetes:

The intraperitoneal injection of alloxan monohydrate, dissolved in normal saline (12.5mg/100g), caused diabetes mellitus. After a 15-day gap, diabetes mellitus was verified using a commercial kit and blood sugar analysis using the Folin-Wu method. On albino rats weighing between 150 and 200 g plus 10 g, the current study was carried out. The experimental albino rats were divided into five primary groups, A, B, C, D, and E, which included rats that were healthy, diabetic, and treated, as well as rats that received micronutrients.

Experimental Design

The current study examined the hypoglycemic effects of micronutrients in diabetic albino rats (Rattusnorvegicus) produced by alloxan (Zinc, Selenium and chromium). Albino rats weighing 150 to 200 g plus 10 g were obtained from breeding facilities for this investigation. The experimental albino rats were divided into five primary groups, A, B, C, D, and E, consisting of rats that were healthy, diabetic, and treated with various micronutrients.

Group-A This group was kept five healthy control albino rats without any micronutrient mixed food for 30 days duration of experiment.

Group-B This group was kept five (without any treatment) alloxan induced diabetic control rats for 30 days duration of experiment.

Group-C This group was kept five diabetic rats and feed upon zinc mixed food (5.0mg/kg body wt.) for 30 days.

Group-D This group was kept five diabetic rats and feed upon selenium mixed food (5.0g/kg body wt.) for 30 days.

Group-E This group was kept five diabetic rats and feed upon chromium mixed food (5.0mg/kg body wt.) for 30 days.

Experimental investigations were made on hypoglycemic effect of micronutrients (Zinc, Chromium and Selenium) in albino rats on the basis of following studies:

1. Histopathological Studies:

Following tissues were taken for histopathological study:

a. Pancreas

RESULTS AND DISCUSSION

These results may offer a hint for evaluating the utility of oral micronutrient supplementation in diabetes individuals. The following haematological, biochemical, and histopathological parameters were observed in the current study:

1. HISTOPATHOLOGICAL STUDIES:

a. Pancreas:

Healthy control group [Fig.- 16]

Control rats' pancreatic tissues displayed the typical lobule architecture. The Langerhans islets also displayed healthy alpha and beta cells.

Exocrine and endocrine functions of the pancreas. Compound secretory alveolar tissue, acini, and duct cells make up the component of the pancreas that performs exocrine activity. At the apices of the acinar cells are dense zymogen granules that carry digestive enzymes. The islets of Langerhans, which produce the hormones glucagon, somatostatin, and insulin, are part of the gland's endocrine function section.

Diabetic control group [fig.- 1]

Alloxan-induced diabetic control rats' pancreatic tissues had a degenerative pancreatic lobule architecture. Alpha and beta cell degeneration was visible in the Langerhans islets. The injured endocrine portion of the pancreas inhibited the hormone insulin's release, which resulted in hyperglycemia in the rats.

*Experimental group treated with zinc, selenium, chromium [fig.- 2,3,4]*When treated with the micronutrients zinc, selenium, and chromium, pancreatic tissues from rats with alloxan-induced diabetes displayed minor pancreatic architectural deterioration. Langerhans' islets displayed a recovery of alpha and beta cells. The injured endocrine portion of the pancreas is rebuilt and begins to secrete some insulin, which causes the micronutrients utilized in the current study to have a hypoglycemic impact.

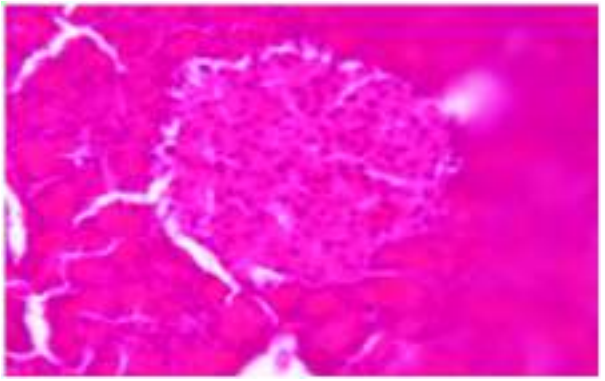

Fig. - 1 : T.S. of Pancreas of healthy control rat (400X)

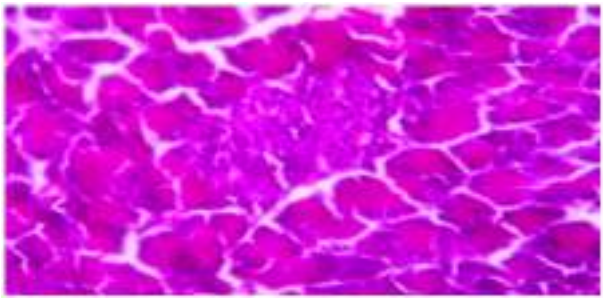

Fig. - 2 : T.S. of Pancreas of Diabetic control rat (400X)

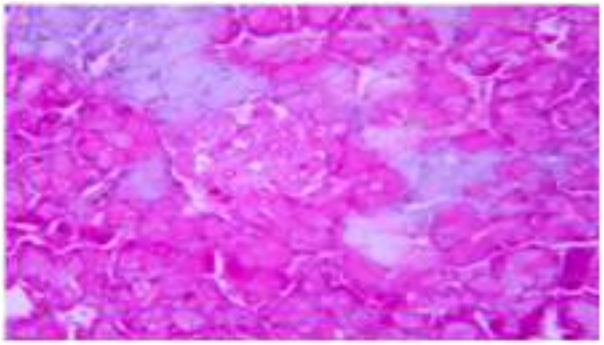

Fig. - 3 : T.S. of Pancreas of Diabetic rat treated with Zinc (400X)

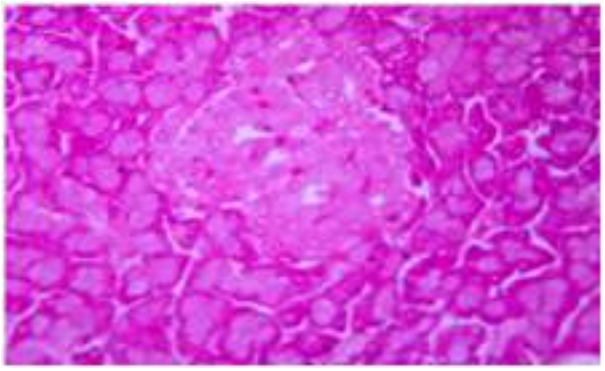

Fig. - 4 : T.S. of Pancreas of Diabetic rat treated with Selenium (400X)

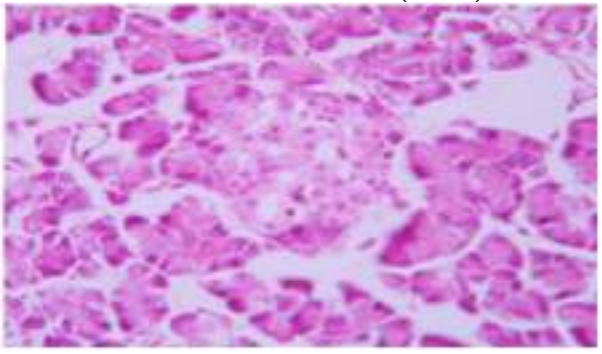

Fig. - 5 : T.S. of Pancreas of Diabetic rat treated with chromium (400X)

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ROLE OF ZOOPLANKTONS IN THE RIVER YAMUNA AND ITS DISTRIBUTION

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ABSTRACT

Zooplanktons are an important component of freshwater ecosystems serving important ecological functions. The purpose of this study was to assess the zooplankton distribution, abundance, and variation in the river Yamuna. Zooplankton could be the bio-indicator of the health status of an aquatic system and their study. The outcome of this study shows that the total number of the Rotifer population, which included Philodinida, Bdelloida, Ploima, and Eurotatoria, was the most prevalent among the several types of organisms in the stretches of River Yamuna. The present study revealed that the water of River Yamuna is contaminated by sewage and other organic pollution.

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Keywords : *Yamuna, zooplanktons, distribution*

INTRODUCTION

The Yamuna is the longest tributary of the Ganga. It flows from Yamunotri in Uttarakhand to Allahabad in Uttar Pradesh (Uttar Pradesh). Its source is the Yamunotri glacier in Shimla, in the Lower Himalayas. It has a large catchment area of approximately 34,25,848 square kilometers and supports a diverse range of aquatic species.

The Planktonic population has a significant impact on aquatic life. Any change in water quality has an immediate impact on the planktonic population, which serves as an excellent indication of the health of the aquatic ecosystem. The organization of the zooplankton community has a lot of potential for determining the health of aquatic ecosystems. According to nutrient status, age, and other locational characteristics, their dominance and seasonality vary greatly in different water bodies. Zooplankton is heterotrophic. Zooplankton is organisms that float in oceans, seas, and freshwater bodies. Zooplankton is the planktonic community's animal component. Even though zooplankton is predominantly transported by ambient water currents, many of them have mobility, which they exploit to avoid predators or improve the pace at which they find prey. Zooplankton plays a function in aquatic food webs by consuming and processing phytoplankton and other food sources, as well as serving as a resource for higher trophic level eaters (such as fish) and as a conduit for packing organic

material in the biological pump.

Classification based on size Zooplankton can be broken down into size classes which are diverse in their morphology, diet, feeding strategies, etc. both within classes and between classes:

Picozooplankton:- <2μm

Nanozooplankton:- 2-20μm

Microzooplankton:-20-200μm

These are also the primary plankton grazers. Heterotrophic and mixotrophic plankton are two types of microzooplankton. Ciliates, dinoflagellates and mesozooplankton nauplii are the most common phagotrophic protists.

RESULTS AND DISCUSSION

Role of Zooplanktons in Food Web

The majority of organic carbon loss from marine primary production is due to grazing by single-celled zooplankton. However, because empirical grazing measurements are scarce, resulting in the inadequate parameterization of grazing functions, zooplankton grazing remains one of the important unknowns in global predictive models of carbon flux, the structure of the marine food web, and ecological features. It has been suggested that a concentrated effort be made to develop apparatus that can link changes in phytoplankton biomass or optical characteristics with grazing to close this essential knowledge gap.

Grazing is a rate-setting activity and a driver of marine biogeochemical cycling in ocean ecosystems. Grazing by heterotrophic protists is the single biggest loss factor in marine primary production in all ocean ecosystems, and it changes particle size distributions. Grazing has an impact on all export production paths, making it crucial for both surface and subsurface carbon processes. The proper modeling of grazing in the global biogeochemical, ecosystem, and cross- biome-comparison models are required for predicting central principles of ocean ecosystem function, including responses to environmental change. Phytoplankton losses, which are dominated by grazing, are the potential reason for annual cycles in phytoplankton biomass, accumulation rates, and export production, according to several large-scale assessments.

Role of Zooplankton in Bio-geochemistry

Zooplankton serves a vital function as carbon and another nutrient "recyclers" that have a substantial impact on marine biogeochemical cycles, such as the biological pump. This is especially essential in the open ocean's oligotrophic waters. Zooplankton release dissolved organic matter (DOM) through sloppy feeding, excretion, egestion, and leaching of fecal pellets, which controls DOM cycling and feeds the microbial loop. The ability of zooplankton to transform and distribute carbon to the deep ocean is further complicated by absorption efficiency, respiration, and prey size.

DOM is generally released by protozoan grazers by excretion and egestion; however, gelatinous zooplankton can also release DOM through mucus formation. The effects of fecal pellet leaching might range from hours to days after the first egestion, depending on the content and quality of the meal. The amount of DOM released by zooplankton individuals or populations is influenced by several factors namely absorption efficiency, respiration rate, and Physical factors like oxygen availability, pH, and light conditions may influence overall oxygen consumption and the amount of carbon lost by zooplankton in the form of CO2. The size differences between zooplankton and prey also influence how much carbon is emitted during sloppy feeding.

Role in Carbon Export

Zooplankton plays an important part in sustaining the biological pump by producing fecal pellets, mucous feeding webs, molts, and carcasses,

among other kinds of carbon export. Fecal pellets are thought to play a significant role in this export, with copepod size rather than abundance determining how much carbon makes it to the river floor. Carcasses are also becoming more well-recognized as significant sources of carbon export. As a result of massive blooms, jelly falls - the mass sinking of gelatinous zooplankton carcasses – occur all over the river bed. This gelatinous zooplankton is believed to have a higher carbon content due to its huge size, making its sinking carcasses a potentially vital source of food.

Abundance and Diversity

The principal zooplankton groups include Rotifers, Cladocerans, Copepods, and Ostracods. They are found in the middle of the food chain. Zooplankton facilitates energy transfer from lower to higher trophic levels (Waters, 1977). As a result, zooplankton plays an important role in the aquatic food chain and play a large role in secondary production in the freshwater ecosystem. In both cold temperate and tropical environments, zooplankton serves as a key indicator of trophic status. Protozoa, Rotifers, Crustaceans, Molluscs, Nematodes, Annelids, and Insects were all found in the Yamuna's whole span (CPCB 2005). There are 38 orders and 1 subclass of zooplankton in the entire Yamuna span (Acari). About 14 orders of Protozoa, 4 orders of Rotifers, 6 orders of Crustaceans, 1 order of Molluscs, 3 orders of Nematodes, 3 orders of Annelids, and 7 orders of Insects have been found in the Yamuna River.

The Rotifer population, which included *Philodinida, Bdelloida, Ploima, and Eurotatoria,* was the most prevalent among all while Rotifers are also an important source of food for Indian Major Carp. Protozoa were the second most dominant group of organisms in the same stretch. *Ciliophora, Hypotrichida, Heterotrichida, Spirotricha, Armophorida, Bryometopida, Odontostomida, Peniculida, Hymen ostomatida, Peritrichida, Suctorida, Testacea, Arcellinida, and Amoebida* are the most common orders of protozoa. Arthropoda and Insecta were the third and fourth largest groups of organisms in the same period, respectively (CPCB 2005).

The water quality of the Yamuna river under investigation has revealed that the pollutant load of the Yamuna river upstream is lower than that of the rivers. According to the water characteristics used in the study, the river water in the YR3 stretch is severely polluted and unsuitable for many aquatic animals, including endangered species. The low-quality trend continues downstream of Delhi, with DO values varying as far as Majhawali and as far as Agra. At Auraiya, though, the figures improved. The biotic community is less researched in the lower stretch (from origin to Tajewala barrage), which can be attributed to the relatively low temperature. Zooplankton, periphyton, zoobenthos, and fishes, on the other hand, are discussed. Due to the high frequency of unprofessional fishing practices, which completely disrupt the zooplankton population and damage the river water quality, the stretch YR1 is experiencing increased resource demand (Badola and Singh, 1977; Nautiyal and Lal, 1994; Uniyal et al.,2006).

The zooplankton population has been discovered to be prospering well in the river stretch affected by Mathura oil refinery waste, indicating that the oil refinery effluent is making the river water more conducive for the development zooplankton population (Prakash and Panwar,2005). In comparison to the Delhi length, the river's water quality improves here. Following the Mathura stretch, the zooplankton population is in the same state. At Etawah, the benthic population formed a large proportion of the organic population. Moza and Kolekar (2002) found that *Chironomus sp*. (an indicator of the polysaprobic zone) and *Cypris sp*.

(an indicator of organic pollution) dominated the benthic population.

CONCLUSION

The zooplankton community is a crucial component of the aquatic food web. These organisms act as a link in the food chain, transporting energy from planktonic algae (primary producers) to the larger invertebrate predators and fish that eat them. By influencing phytoplankton production and altering pelagic habitats, zooplankton plays an important role in the pelagic food web. Furthermore, the dynamics of zooplankton populations have a considerable impact on recruitment to fish stocks due to their vital role as a food source for larval and juvenile fish. The biodiversity of zooplankton is essential to keep our ecosystem healthy because each species plays a specific role (recycling nutrients, food for another, and maintaining soil fertility) in the ecosystem and some species may allow the natural ecosystem to function healthily. Therefore, to keep the river alive and usable, some conservation work must be done early on, and the minimal amount of water required for biodiversity and self-purification of the river must be maintained.

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EFFECT OF ECO - FRIENDLY MANAGEMENT OF LATE BLIGHT OF POTATO CAUSED BY PHYTOPHTHORA INFESTANS (MONT.) DE. BARY

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ABSTRACT

Potato (Solanum tuberosum L.) is the world's fourth most important food crop after wheat, maize and rice, and provides a balanced source of starch, vitamins and minerals to many communities in almost all over the world. It is considered as a "King of Vegetable". The main reasons of low productivity of potato is diseases namely early blight, late blight, common scab, leaf spot, dry rot, charcoal rot, black scurf, soft rot, leaf roll etc. Among them Late blight of potato, which is caused by Phytophthora infestans (Mont.) de Bary. It is the best known, that this late blight disease is highly destructive among all the potato disease. Late blight is probably the single most important disease of potatoes worldwide. In the present investigation, a survey was conducted during Oct to March 2020-21 at Organic Research Farm, Kargaunji, Department of Plant Pathology, Institute of Agricultural Sciences, Bundelkhand University. An experiment has been conducted to observed the disease severity of late blight of potato in different weather parameter viz. Temperature °C, RH %, Rainfall (mm), Evaporation (mm). Weather data were collected on weekly. A significant role of weather parameter was detected in disease in disease development and disease progress. Among the different Trichoderma spp. and plant extracts on number tubers per plant, tubers yield t ha-1 , Per cent Disease incidence and percent disease control was found positive and significant. The maximum tubers yield (18.25 t/ha) was recorded in treatment T1- Trichoderma viride. The minimum tubers yield (10.55 t/ha) was recorded in control treatment. The tubers yield (17.75 t/ha), recorded from Datura leaf extract treated plot was higher than other plant extract treated plot. Thus, the present study showed that bio-agent and plant extracts treatment have a good control ability of the disease and it may be a better alternative of chemical disease management in sustainable agriculture.

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Keywords : *Trichoderma spp., plant extracts, effect*

INTRODUCTION

Potato (*Solanum tuberosum* L.) is the world's fourth most important food crop after Wheat (*Triticum aestivum* L.), Maize (*Zea mays* L.) and Rice (*Oryza sativa* L.), and provides a balanced source of starch, vitamins and minerals to many

communities in almost all over the world (Rowe, 1993). It is considered as a "King of Vegetable". Potato is grown in almost all type of soil, but they prefer moist and acidic soil (pH slightly less than 6) (Anonymous, 2018).

The production of potato in India is quite impressive but productivity level is very low as compare to other countries of the world. The main reasons of low productivity of potato is diseases namely early blight, late blight, common scab, leaf spot, dry rot, charcoal rot, black scurf, soft rot, leaf roll etc. Among them Late blight of potato, which is caused by *Phytophthora infestans* (Mont.) de Bary is the major bottleneck in potato production in Ethiopia and other parts of the world. It is the best known, that this late blight disease is highly destructive among all the potato disease. Late blight is probably the single most important disease of potatoes and tomato worldwide. Worldwide losses due to late blight of potato are estimated to exceed $5 billion annually and thus the pathogen is regarded as a threat to global food security (Latijnhouwers *et al*. 2004). Late blight was responsible for the Irish potato famine in the 1840s (Mercure 1998).

Khurana *et al.,* 1998 stated that late blight of potato caused by *Phytophthora infestans* (Mont.) de Bary is one of the most serious and destructive disease of potato all over world, including India. The great Irish famine in 1845, due to late blight is one of the most dramatic episodes caused by a plant pathogen in human history.

Management of the disease can be done through biological management and need based use of fungicides but the management practices are not economical and eco-friendly**.** So our management practices should be focus on Eco-friendly preventive or prophylactic measures that will reduce the initial inoculum resulted slow development of disease. As compared to insect pest management, disease management requires much more judicious approach.

MATERIALS AND METHODS

The research work was carried out in the Organic Research Farm, Kargaunji, Department of Plant Pathology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi during crop season 2020-21.

Three isolates of Trichoderma Spp. (*Trichoderma viride, Trichoderma harzianum* and *Trichoderma virens* - conc. was 5×10^{-6} spore / ml), five Plant Extracts (Concentration 5%) were selected for the present study *viz*., leaves of Tulsi, Datura, Lemon grass, Neem and bulb of Ginger were used. The experiment constituted of 9 treatments, laid out in Randomized Block Design , with three replications.

Fresh leaves and bulb were collected and washed thoroughly in clean water. Hundred gram of each washed plant material was grinded in Pestle and Mortar by adding equal amount (100 ml) of sterilized water (1: 1 w/v) and heated at 80 °C for 10 minutes in hot water both. The materials was filtered through double layered muslin cloth followed by filtering through sterilized Whattman No.1 filter paper and treated as standard plant extract (100%).

The pathogenicity test of isolated fungus was conducted on healthy potato plants in order establish the pathogenic nature of the fungus. The pathogenicity was tested according to Koch's postulates (1882).

Observations on disease incidence, Percentage of disease control, growth parameters yield attributing and yield were recorded. In each plot, five random select plants were tagged to record the observations. By taking the average, the mean value for the treatment was calculated.

Per cent increase in yield

Per cent yield increase due to different treatments was calculated in each season using following

formula:

$$\text{Percent increase in yield} = \frac{\text{Yield treated plot - Yield in check plot}}{\text{Yield treated plot - Yield in check plot}} \times 100$$

Per cent Disease incidence :

Observations for measuring the per cent disease incidence were taken after 5 days of pathogen inoculation. The disease severity was recorded on a 0 - 9 scale. Ten leaves randomly selected from the plot for measurement of disease severity. The leaves with 1 – 9% infection received 1, 10% infection received 2, 11 – 25 % infection received 3, 26 – 40 % infection received 4, 41 – 60 % infection received 5, 61 – 70 % infection received 6, 71 – 80 % infection received 7, 81- 90 % infection received 8, 91 – 100% infection received 9. The per cent disease incidence of individual plants was calculated by following formula given by (Malcolimson, 1985).

$$\text{PDI (\%)} = \frac{\text{Sum of numerical rating}}{\text{Total number of leaves examined x maximum rating}} \times 100$$

Per cent disease control

The data on disease incidence was recorded on a day before spraying and 10 days after each spray and final incidence was recorded before harvest. The per cent disease control was calculated by using the formula given by Vincent, (1927).

$$\text{Percent disease control} = \frac{(C - T)}{C} \times 100$$

Whereas,

C = Per cent disease in control

T = Per cent disease in treatment

Statistical analysis :

The data were analyzed by following the procedure of Randomized Block Design (RBD). Data recorded in percentage were first transformed at Arc sin value

(Fisher and Yates, 1949) $\sqrt{\text{Sin}^{-1}}$ before statistical analysis. Treatments were compared by means of critical difference (CD) at 5 per cent level of significant.

RESULTS AND DISCUSSION

Symptoms, morphological identification and Pathogenicity test of late blight of potato

Symptoms appear at first as water-soaked spots, usually at the edges of the lower leaves. In moist weather the spots enlarge rapidly and form brown, blighted areas with indefinite borders. A zone of white, downy mildew growth 3 to 5 millimeters wide appears at the border of the lesions on the undersides of the leaves. Soon entire leaves are infected, die, and become limp. Under continuously wet conditions, all tender, above ground parts of the plants blight and rot away giving off a characteristic odor. Entire potato plants and plants in entire fields may become blighted and die in a few days or a few weeks.

Phytophthora species produce sexual spores (oospores) and asexual spores (zoospores). The morphological characters of sex organs (oogonia and antheridia) and zoosporangia are used for grouping *Phytophthora infestans.* The sporangia are multinucleate (7-30 nuclei), thin – walled, hyline, oval or pear shaped with a definite papilla at the apex. They measure 22-33µm × 16-24µm. Sporangia develop at the end of these sporangiophores. The fertilized oogonium develops into a thick – walled oospore, while the oospores are orange red, nearly round – shaped, measurement of 28 - 32µm.

The pathogenicity test of isolated fungus was conducted on healthy potato plants in order to establish the pathogenic nature of the fungus. The pathogenicity was tested according to Koch's postulates (1882).The earthen pots of 30 cm diameter were taken to conduct the present experiment. Initially the pots were filled with sterilized soil and water was added to bring the soil under good tilth condition. The healthy tubers of potato variety Kufri Pukhraj were placed and were allowed to grow for one month. The homogenized

spore suspension was prepared in sterilized water from 7 days old culture. The suspension was sprayed on one month old potato plants @ 2 ml/plant. The inoculated plants were placed on the bench of glass house. After 2-3 days, the plants began to show the symptoms of blight. The inoculated plants showed pale to dark green spots occur at the leaf tips and margins that change into brown or black lesions later. These lesions are not delimited in size and enlarged rapidly in a favorable weather. On the lower side of leaves, a white mildew appears on the surface of lesions where the pale and purplish tissues join. These symptoms confirmed that the blighting was caused by *Phytophthora infestans.* Re- inoculations were made from infected plant and culture was compared with original cultures to confirm the identity and pathogenicity of the pathogen.

Effect of different treatments on tubers yield

Tubers yield (t ha^{-1}):

Data pertaining to tubers yield (t ha^{-1}) of potato during experimentation as influenced by *Trichoderma* isolates and different plant extracts over control are presented in Table 1.1. It is evident from the data that potato treatments exerted significant variation on tubers yield. Among the different treatments, maximum tubers yield was recorded with T_1- *Trichoderma viride*, representing (18.25 t ha^{-1}) followed by T_5- Datura leaf extract, representing (17.75 t ha^{-1}) and T_2- *Trichoderma harzianum*, presenting (16.50 t ha^{-1}) proved significantly superior to rest of the treatments and minimum tuber yield was found in T_9- Control, presenting (10.55 t ha^{-1}) respectively, during investigation. It is also cleared from the table that all the *Trichoderma* spp. and different plant extracts showing significantly superior to over control. Similar findings was reported by Malathi, *et. al.,* (1995) and Hamed, (1999).

Percent increase in tuber yield over control:

An examination of data shows that percent increase in yield over control of potato significantly increased and maximum percent increase in tubers yield was found in T_1 – *Trichoderma viride*, representing (72.98 %) followed by T_5- Datura leaf extract, representing (68.25 %) and T_2- *Trichoderma harzianum*, presenting (56.40 %) these treatments proved significantly superior to rest all the treatments and minimum percent increase in tuber yield was observed with T_6- Lemon grass leaf extract (25.12 %), respectively. It is also cleared that all the *Trichoderma* spp. and different plant extracts are showing significantly increased the tubers yield of potato over control during investigation. Similar results was supported by Saikia, *et al.,* (1999) and Muthukumar, *et. al.,* (2011).

Table - 1.1 : Effect of *Trichoderma* spp and different plant extracts on tuber yield and per cent disease control of potato during 2020-21

Treatments	Tuber yield (t ha^{-1})	Per cent increase in yield over control
T_1- *Trichoderma viride*	18.25	72.98
T_2 – *Trichoderma harzianum*	16.50	56.40
T_3 – *Trichoderma virens*	15.45	46.45
T_4 – Tulsi leaf extract	14.10	33.64
T_5- Datura leaf extract	17.75	68.25
T6 – Lemon grass leaf extract	13.20	25.12
T_7- Neem leaf extract	14.65	38.86
T8 – Garlic bulb extract	15.85	50.24
T_9 – Control	10.55	-
SEm±	0.22	-
CD at 5%	0.68	-

Per cent Disease incidence :

All the treatments reduced the per cent disease incidence of potato as compared to Control (water sprayed plot). The minimum per cent disease

incidence of potato were recorded in T_1- *Trichoderma viride*, presenting (10.75 %) followed by T_5- Datura leaf extract, representing (11.63 %) and T_2- *Trichoderma harzianum*, presenting (13.24 %) and maximum per cent disease incidence of late blight of potato was observed with T_9- Control (28.25 %). It is also cleared that all the *Trichoderma* spp. and different plant extract showing significantly superior to over control during investigation. Similar work has been done by Anju Rani *et al.,* (2006) evaluated the efficacy of five neem formulations (Tricure, Neem Gold, Floriguard, Vegfru-guard, Neem) and one botanical extract (Wanis) against late blight (*Phytophthorainfestans*) of potato cv. Kufri Bahar.

Percent Disease Control:

Marked variation was also noticed between the different treatments in respect to percent disease control (%). Among different treatments, maximum percent disease control was recorded with value T_1- *Trichoderma viride*, presenting (61.95 %) followed by T_5- Dadura leaf extract, representing (58.83%) and T_2-*Trichoderma harzianum*, presenting (53.13 %) these treatments are proved significantly superior to other treatments and minimum percent disease control (%) was found in T_6- Lemon grass leaf extract (30.97 %) during experimentation, respectively. It is also cleared that all the *Trichoderma* spp. and different plant extracts showing significantly superior to over control during investigation. Blaeser and Steiner (1998) examined the efficacy of 35 plant extracts against *Phytophthora infestans* on tomato plants under greenhouse conditions. Of the tested plant extracts, 32% showed efficacies between 50-80%; only 5% of the extracts had an efficacy over 80%. The greatest antifungal effects were achieved with the extracts of *Potentilla erecta (90%)* and *Salvia officinalis* (83%).

Table - 1.2 : Effect of *Trichoderma* spp different plant extracts on per cent disease incidence of potato during 2020-21

Treatments	Per cent disease Incidence	Per cent disease control
T_1- *Trichoderma viride*	10.75	61.95
T_2 – *Trichoderma harzianum*	13.24	53.13
T_3 – *Trichoderma virens*	16.72	40.81
T_4 – Tulsi leaf extract	18.45	34.69
T_5- Datura leaf extract	11.63	58.83
T_6 – Lemon grass leaf extract	19.50	30.97
T_7- Neem leaf extract	17.85	36.81
T_8 – Garlic bulb extract	14.35	49.20
T_9 – Control	28.25	-
SEm±	0.25	-
CD at 5%	0.74	-

CONCLUSION

On the basis of the above findings of the present investigation the effects of different *Trichoderma spp.* and plant extracts on plant height, fresh and weight of shoot, root length, fresh and dry weight of root, number of branches per plant, number of stolen per plant, number tubers per plant and fruits yield was found positive and significant. The maximum tubers yield (18.25 t/ha) was recorded in treatment T1- *Trichoderma viride*. The minimum tubers yield (10.55 t/ha) was recorded in control treatment. The tubers yield (17.75 t/ha), recorded from Datura leaf extract treated plot was higher than other plant extract treated plot. Thus the present study showed that bioagnest and plant extracts treatment have a good control ability of the disease and it may be a better alternative of chemical disease management in sustainable agriculture.

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STRESS MANAGEMENT PRACTICES WITH DIGITAL HUMOR TO IMPROVE QUALITY OF WORK LIFE

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This study aims to manage stress through digital humorin an effort to improve the quality of work life. The research method uses a quantitative approach. The work stress that a teacher feel is quite high, that is, when a teacher is more intense in the use of humor in digital media, in the middle of his work schedule, the work stress that he feels will actually increase, then the perceived quality of work life will actually decrease. But in this study, it was not possible to verify that the work stress variable is significantly related to the influence of digital humor on the quality of work life.

Keywords : *Digital humor, quality work life, work Stress.*

INTRODUCTION

Human Resources in the world of education are also required to give their best performance, one of which is the world of education at the tertiary level where the teaching staff, namely lecturers, always interacts with the state of their work, both in internal and external tasks such as the wider community, government and other task activities (Budawati, 2016).The hefty demands of the Lecturer task can cause stress if they are unable to adapt between desires and existing realities, both inside and outside of themselves. All forms of stress are basically caused by a lack of understanding of human's own limitations. It is this inability to fight against limitations that creates frustration, conflict, anxiety and guilt. Stress is a condition of tension that creates physical balance, which affects emotions, thought processes and the condition of an employee. Too much stress can threaten a person's ability to cope with the environment. As a result, employees develop various kinds of stress symptoms that can interfere with their work performance (Budawati, 2016).

The perception that arises about every task that is accepted and that must be done is that the task is very heavy; lack of the resources needed to carry out the assigned duties and responsibilities; or do not have enough ability to be able to achieve the expected results. When such feelings arise in a person, it can be said that the person is experiencing work stress.Various attempts were made to be able to manage, reduce or avoid stress, one of which is by enjoying humor (Reyes, 2012). The perception that appears every time you hear the term humor cannot be separated from something that is considered funny, fun, and entertaining. Besides having these characteristics, humor also actually has a positive impact, which is able to encourage the emergence of

positive emotions (Collum et al., 2011) and improve human health (Samson et al., 2008).

Along with the development of communication and information technology, then humor that was previously spread through conventional means, such as with television intermediaries, in stage shows, or in forums that are formal or informal, so now humor can also be disseminated through the media on line. The digital media makes it easier for each individual to spread and accept humor in various forms, both in the form of interactive humor, funny photos, manipulations, phanimation, celebrity soundboards, and PowerPoint humor (Shifman, 2007).

WhatsApp is one of the media online that is widely used by people to communicate and interact with one another in the digital world. In practice, the use of WhatsApp is not only for non-formal social communication, but also for work purposes. On the one hand, the existence of WhatsApp encourages work-related communication to be more effective and efficient, but on the other hand there is also a negative impact that is felt, where delegation of tasks or work-related conversations is carried out without knowing the time. This phenomenon is also experienced by lecturers who are members of the group WhatsApp Lecturers Community.

When this happens continuously, the lecturers feel that they don't have enough time to rest and be free from various work demands. Aware of this, the lecturers who are members of the group WhatsApp Lecturer Community also try to reduce the work pressure that is felt by often sharing funny content in the group WhatsApp. Thus, WhatsApp is not only used for the sake of social communication and work, but also as a place to share humor.

The relationship between digital humor and work stress is important to be re-examined considering work stress has a relationship with quality of work life (QWL) (Ramya & Poornachandran, 2017) and work stress can be influenced by humor (Collum et al., 2011; Wijaya, 2017). QWL is defined by Kossen (1986) as thoughtsor opinions held by employees regarding the state of the work environment and the experience gained while carrying out work in a company.

LITERATURE REVIEW

Symbolic Interaction

Theory of symbolic interaction was developed based on the thought of George Herbert Mead (1863-1931) into two streams, namely the flow of Chicago and Iowa. The Chicago school with its pioneer Herbert Blumer (1962) uses a qualitative approach to understand the concept of social interaction with human main actors who have positive characteristics in the form of the ability to innovate, think and act creatively, and be able to adapt to uncertain circumstances. Humans are part of a society that is having a social process (Ahmadi, 2005). The second stream, namely Iowa with its pioneer Manford Kuhn emphasizes the position of the individual as the main capital for social interaction through his tendency to think, behave, and behave based on self- concept. In other words, interaction between individuals is a form of self-concept expression to achieve a social goal through representative symbols of this self-concept (Ahmadi, 2005). Symbolic interaction theory is formed by three basic concepts, namely Mind, Self, and Society (Ardianto et al., 2007).

Mind if translated freely means mind, is part of individuals who experience development along with the increased social interaction through. Thoughts are the result of social interaction, which allows individuals to have various responses to the symbols they receive, and is able to become the basis for the creation of symbols by the individual.

Self is a concept that is a fundamental differentiator between humans and animals. The concept of self refers to the ability of humans to

control and evaluate their thoughts, attitudes and behavior. Based on this concept, the individual will be able to choose the symbols that are considered the most appropriate to represent himself, as well as be able to interpret the symbols that are accepted in the social interactions that they pass. Society is a concept that has a broad scope and is the basis for the concept of mind and self.

Job Stress

Robbins & Judge (2015) states that work stress arises as a result of conflicts between individuals, both physically and psychologically, with conditions or problems encountered in carrying out work activities. The situation or problem can be related to work demands, opportunities that must be utilized, or related to the condition of resources needed to carry out productive activities. Gibson et al. (1993) states the same thing, that work stress is a form of reaction to the individual that arises because of demands from the work environment that do not have compatibility with the physical or mental capabilities of the individual. Mangkunegara (2008) specifically states that job stress is something that many employees who work at a company experience, which have an impact, either directly or indirectly, on the employee's attitudes, feelings, thoughts, and behavior. The higher the work stress, the more unstable feelings or emotions, the more negative attitudes and behaviors, and the more tense the mind is filled with anxiety.

According to Hariyono (2004), job stress arises due to one's inability to cope with conditions or problems encountered at work. Employees who experience work stress will become less productive and tend to not be able to develop properly in accordance with the demands of the company. The employee will even have difficulty interacting with various important aspects of his job, including with colleagues, supervisors or supervisors, or with company relationships or customers.

Job stress can be measured using two dimensions, namely (Cohen & Williamson, 1988): Perceived helplessness is a feeling that an individual has that he does not have control over the surrounding environment, so that the individual is in an uncomfortable, unmotivated, and emotional state. Perceived self-efficacy is a feeling that is opposite to perceived helplessness in which individuals have a strong belief in the ability of oneself to do various things that are desired to achieve certain goals.

Coping Stress through Humor

Individual efforts to deal with stress are commonly known as coping. This means that the strategies undertaken by individuals cannot be considered better than other individuals. The effectiveness of a coping strategy is only determined by its impact in a specific situation and its impact in the long term. There are many ways to coping with existing stress, both those that focus on the problem, emotions, or how to assess a condition. The means used for coping also vary, one of which is stress coping using humor. Some proverbs that are widely known states that "laughter is the best medicine". According to Markman (2017), a cognitive scientist from the University of Texas, humor can affect the way a person sees problems and reduce stress experienced. The view that humor has positive benefits in dealing with stress is in line with the results of several studies that have been conducted, which show that individuals with good sense of humor and using it as a coping strategy will be better able to deal with stresses that hit and adjust (Wu & Chan, 2013; Overholser, in Martin, 2007).

However, the use of humor as a coping strategy is not always beneficial. According to Markman (2017), improper use of humor, such as making oneself or another person a joke can make others have a negative view and reduce social support, which can impact on higher stress levels. In addition, the use of humor as a coping strategy is

also not universal. For example, in China, humor is seen as dishonorable. This is due to the culture adopted, so individuals must continue to maintain behavior in accordance with polite and polite ethics (Yue, 2010). The data above are some of the results of research that are inconsistent with the results of research which show the positive impact of using humor as a coping strategy.

The Humor Style Model

Kuiper (2012) has the concept that a sense of humor is a characteristic of individual diversity that involves four main styles, namely, affiliative, self enhancing, aggressive, and self-defeating humor. Both Humor styles affiliative and self-enhancing generally touch on the positive or adaptive aspects of the sense of humor; whereas aggressive and self-defeating styles generally touch on negative or maladaptive aspects of the person.

Martin et al. (2003) &Oktug (2017) further explain four characteristics of humor, including:

Affiliative is humor or jokes created to encourage increased relationships between individuals. The characteristics of humor include non-offensive, tolerant, cheerful, containing positive emotions, and maintaining self-esteem.

Self-enhancing is humor that aims to defend oneself to avoid negative or nonconductive situations that have the potential to harm oneself. The characteristics of humor include being open, maintaining self-esteem, psychologically healthy, and focusing on internal psychological aspects.

Aggressive is humor that is carried out without regard to its impact on others by saying funny words that actually have the potential to hurt or hurt the feelings of others. The characteristics of this humor include sarcasm, tease, and ridicule, condescend, and insult. This humor is also closely related to situations of anger, aggression, harm, and neuroticism.

Self-defeating is humor that is done by humbling oneself to create jokes for others. This humor is characterized by a form of defensiveness or refusal to cover up negative feelings. Humor is related to emotional needs, avoidance, low self-esteem, and anxiety

Digital Humor

Humor is a term that is often used in everyday life to describe something that is funny and entertaining. The definition of humor mentioned by Reyes et al. (2012) as "the presence of amusing effects, such as laughter or well-being sensations", that is, humor is something that can create confusing effects, which canmake people laugh or feel happy sensations. A similar definition of humor was stated by Martin (2003), that humor is a construct that has many dimensions, which mainly has the ability to present feelings of pleasure to oneself and others. Humor can come from a certain pattern of behavior or attitude from someone, which is generally used to build social relationships.

In accordance with the increasingly rapid development of communication and information technology, humor that was originally created and delivered through conventional means, such as being staged on the stage, aired on television stations, or delivered in direct interaction between individuals, both in formal and informal settings At this time, it can also be conveyed using various types of online media, so that people can more easily accept various types of humor and consume them as a means to release tension or stress caused by various problems encountered in daily life or at work. The digital world in addition to making the spread of humor easier and wider, also causes the development of forms of humor to become more varied. According to Shifman (2007), interactive humor in the form of text contains funny words that require the active participation of the humor recipient to do certain things rather than just reading, listening, or seeing.

1. Funny Photos are photos that display a funny message, which are generally often presented with a funny text that provides additional descriptions.
2. Maniphotos are photos that are manipulated by combining them with other photos to create a funny or weird impression.
3. Phanimation is a moving or animated version of maniphotos.
4. Celebrity Soundboards are digital collections of film and/or voice clips that appear on television or radio owned by actors, which are intentionally quoted in the form of sound clips or short videos containing funny or strange messages.
5. PowerPoint Humor is funny text or images presented in the form of a presentation PowerPoint.

Quality Work Life

Luthans (2011) provides a more specific meaning, that QWL is "... a concern about the impact of work on people and organizational effectiveness combined with an emphasis on participation in problem solving and decision making", that is, QWL is related with the impact of work on individuals and also related to organizational effectiveness which is supported by an emphasis on participation in problem solving and decision making. In essence, Luthans (2011) defines QWL as an individual perception of organizational employees on the active role of the organization in meeting the various needs of employees, and positions employees as an integral part that is recognized as important by the organization.

Specifically, Wirawan (2015) mentions eight efforts that companies can make to create QWL, namely:

1. Providing adequate and fair compensation.
2. Creating safe and healthy work procedures.
3. Facilitating HR development needs.
4. Providing guarantees to career development and security of positions for HR.
5. Creating social environments that is conducive to create organizational norms that guarantee individual rights.
6. Increase work effectiveness and efficiency to provide a balance to employee life, namely between work and personal life.
7. Creating a connection between all elements of the company and the social environment outside the company.
8. Quality of Work Life (QWL) can be measured using four dimensions, namely (Wirawan, 2015):
   - 8.1. The level of employee involvement in problem solving
   - 8.2. The formulation of compensation is constantly developing.
   - 8.3. Restructuring of work
   - 8.4. Improving the work environment

Effect of Digital Humor on Quality of Work Life through Mediation of Work Stress

Testing the effect of digital humor on quality of work life through mediation of work stress is done by using manual calculations by comparing the results of the interaction of the two regression coefficients of the direct influence of the effect of digital humor on work stress and work stress on quality work life, which is then compared with the regression coefficient of the direct effect of humor on quality work life.

Through the calculation process, it is found that the indirect effect given by the quality of the work environment on employee performance has a smaller coefficient value than the direct effect, where not all of the resulting direct coefficients are significant. So it can be concluded that the work stress variable is not proven as a mediating variable in the influence of digitalhumor on the quality of work life.

This can be because, in this study, contradictory results were found on the exposure to the direct influence described earlier where not always the humor performed by the lecturers would be able to reduce the tension at work, and not always that when a lecturer experienced tension or stress at work at a high level will always reduce the quality of his work life. This is suspected to be the cause of work stress variables not proven as mediating variables in the effect of digital humor on quality of work life. Even though in reality, when fatigue arises due to problems in work life within the lecturers' environment, the majority of the lecturers vent their emotions with the flavor of "humor" in the group of WhatsApp the lecturer community, with the consideration that the group consists of fellow lecturers and is considered the right space for sharing, to vent emotions through humor due to work stress experienced in carrying out their profession. The lecturers considered that the humor in the media group WhatsApp that they did could be categorized as a "model for managing work stress through digital humor". They hope, by managing the stress from the lecturers through digital humor, the level of stress they feel can be reduced or even become unstressed which will ultimately be able to improve Quality Work Life (QWL). But they forget not to pay attention to aspects of the constraints of both the time and the categories of humor brought up, morally and ethically, so that the findings produced are out of habit.

CONCLUSION

The influence given by digital humor on work stress is unidirectional and the significance value is below the critical value indicating that the effect given is very real. This implies that if a lecturer is more intense in utilizing digital media of humor in between his busy work, the work stress he feels will actually increase.

The influence given by digital humor on quality of work life is the opposite direction and thesignificance value above the critical value shows that the influence exerted is not real. This implies the meaning that if a lecturer is more intense in utilizing digital media humorin the midst of his busy work, the quality of work life perceived will actually decrease. The effect that work stress has on the quality of work life is unidirectional and the significance value above the critical value indicates that the effect given is not real. This implies that the work stress felt by a lecturer is quite high, so the quality of work life owned by a lecturer will increase as well.

The indirect effect given by the work environment on employee performance has a coefficient value smaller than the direct effect, where not all of the direct coefficients produced are significant. So it can be concluded that the work stress variable is not proven as a mediating variable in the influence of digital humor on the quality of work life.

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ECONOMICS OF POTATO PRODUCTION IN RAEBRAILY DISTRICT OF UTTAR PRADESH

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ABSTRACT

India is predominantly an agricultural country and potato is one of the major cash crops of India as well as Uttar Pradesh. Potato crop significantly contributed to the agricultural economy due to its dominance in the consumption basket of the almost every household. The present study was conducted to estimate the cost and returns of potato on different size of sample farms during 2020-21 in purposively selected salon Block of Raibareli District Uttar Pradesh. 100 Potato growers were selected from five villages through proportionate random sampling method. Cost of cultivation showed the increasing trend with the category of sample farms. The average cost of cultivation in the study area was Rs.48082.25 per hectare. Seed contributed a maximum share among different cost items. It was estimated Rs. 13168.88 per hectare. Cost of production per quintal of potato was computed to Rs. 193.13 in study area. Overall benefit-cost ratio was found 1:3.42 potato crop. The present study indicated that potato is a labor intensive crop and the profit of the crop can be rationalized by the use of human labour and machinery charges. The major constraint recorded in the study area was price fluctuation at the time of harvesting.

Keywords : *Cost of cultivation, potato crop, cost of production, benefit-cost ratio.*

INTRODUCTION

Agriculture is the backbone of Indian Economy due to fifty eight percent of the total population either directly or indirectly depends on agriculture for their livelihood. In India agriculture contributes approximate 15 per cent of total GDP and 10 per cent of the total exports. (Economic survey 2018- 2019). Potato is one of the major cash crop of India as well as Uttar Pradesh. Potato (*Solanum tuberosum* L.) generally known as 'The king of vegetables', and it is also known in the form of staple food for most of the population of India after cereals. India has secured second place in production of potato after China in the world. The area under potato cultivation was 2.14 million hectare with the total production of 51.31 Million toones in 2017-18 (Horticulture Statistics at a glance 2018). It was also observed that the area is almost constant during 2015 to 2019 i.e. 2.1 million hectare while the production has increased from 43 MT to 52 MT. In Uttar Pradesh the total area under potato cultivation was 0.6 million hectare with the production of 15.55 million tones.Uttar Pradesh is the highest potato producing state in India (15.55 MT) followed by West Bengal (13.78 MT), Bihar (8.10 MT), Gujarat (3.70 MT) and Madhya Pradesh

(3.27 MT) respectively. Potato is generally used in the form of mashed, cooked as a whole or in the form of potato flour also used in baking and as a thickener for sauces. The tubers are highly digestible and supply vitamin C, protein, thiamin, and niacin. Being a major vegetable, it has the huge importance to the processing industry as well. Many processed products of potato such as potato chips, French fries, potato flakes etc. are available in the market. The demand for processing Potato is likely to increase in India due to increased urbanization, preference for fast foods, rising per capita income and because of increased demand for convenience food. The most popular processed products are chips and French fries. Processing is mainly confined to developed countries and it is only in its infancy in most of the developing countries with the exception of China (12%), Korea (6%) and Mexico (8%). In India, processing of Potatoes constitutes less than 0.5 per cent of the annual production. To consider the needs of the monetary perceptive of potato cultivated farmers and nutritional value of potato to the country, the present study is conducted to assess the existing cultivation practices, production, productivity, cost, income and benefit of potato production in the Raibaraily District of Uttar Pradesh.

LITERATURE CITED

(Sharma et al.) 2017, studied the Economics of Potato Production In Kangra District Of Himachal Pradesh, India and reported that the potato crop was found to be more capital and labour intensive due to substantial cost incurred on different input items (seed, fertilizer and human labour). Out of the total cost of Rs. 135317, the human labor alone shared for around 35 per cent, followed by seed (23%). As such, the output input ratio over all paid out cost was 1:1.39.

(Raghuvanshi et al.) 2018, conducted research on Trends and economics of potato cultivation in Chhattisgarh and found that the status of potato crop has improved drastically among the farmers of Chhattisgarh over the last few years. Cost of cultivation showed an increasing trend from marginal to large farmers. The average cost of cultivation of potato was found Rs 75839.72. The major share of cost among different cost items was founded in seed which accounts 37.65 per cent of the total cost of cultivation. Overall input-output ratio was found 1:1.89 in potato crop.

(Soren and Bera) 2010, studied the economic feasibility analysis of potato cultivation in West Midnapur district of West Bengal and reported that cost of cultivation, the crop required an initial investment amounting Rs. 68461.301 ha and yielded a total return and net return of Rs. 87409.31 and Rs. 14178.271 ha respectively, with return-cost ratio of 1.19 measured by using farm management cost concept. Based on the prime cost concept, these values were worked out to be Rs. 47812.61, Rs. 87409.31 and Rs.39222.77 with return-cost ratio of 1.81 in the same order.

(Kumar et al.) 2021, conducted research on economics of potato production in Gorakhpur District of Eastern Uttar Pradesh and found that the overall cost of potato cultivation was worked out to be Rs 96272.30 per hectare. Which was highest for large (Rs.109402.21) size of holding followed by medium (Rs. 101713.80), small (Rs. 90349.28) marginal (Rs. 83623.96) size of holdings. The overall, cost A1 accounted 60.87 percent of total costs (cost C3). Cost A1 and cost A2 were found to be same as there was no land was taken on lease. Cost B1, cost B2, cost C1 and C2 was found to be 61.70, 82.15, 70.45 and 90.91 percent of cost C3, respectively. The cost C3, which take into account the managerial function performed by farmers was Rs.105899.53.The overall value of gross income, net income, farm business income and family labour income per hectare came to Rs. 257440.38, Rs.

161168.08, Rs. 192972.85, and Rs. 170435.55 respectively. The B: C which indicates the profitability of investment was observed to be 2.67 at the overall level.

MATERIALS AND METHODS

Raibareli District of Uttar Pradesh has selected purposively to avoid the operational inconvenience. A list of all the 18 blocks of the Raibareli district was prepared and out of 18 blocks one block Salon having the highest acreage under potato was selected purposively. From the selected block, a list of all villages was prepared and five villages were randomly selected on the basis of maximum coverage of the area under potato crop. From the selected villages a list of farmer's potato growing farmers was prepared and arranged in ascending order according to the size of their operational holdings, Further the farmer was categorized into three categories, i.e. (i) marginal (below < 1ha) , (ii) small (1 to 2 ha) , (iii) medium (2 ha and above). Ultimately. 100 number of farmers were selected proportionally from each category of farmers. There are 67 marginal 24 small, and 09 medium farmers from five selected villages (Kanhpur, Lahurepur, Kmalganj, Pandit ka Purwa and Kamalludin Pur) of one block from Raibareli district. After the selection of the respondents a well structured survey schedule was prepared and tested. The primary data at farm level and required information on potato growing farmers pertaining to crop year 2020-21, (January-April) collected by personal survey method. The collected data were analyzed by using the tabular method. Mainly tabular and simple percentage analysis method has been applied to inference some meaningful conclusions.

Analytical Procedure

Estimation of Costs and Returns

The farm management, cost concept approach is widely used in India for evaluating crop profitability in production. The cost concepts in brief, are Cost A1, A2, B1, B2, C1, C2, and cost C3.

COST A1: This gives the total cash expenses incurred by the owner or operator. It includes the following terms of costs.

1. Value of hired human labour. (Agarwal and Kumar, 2018)
2. Value of bullock labour.
3. Value of machinery charges
4. Value of fertilizers and manures.
5. Value of seeds.
6. Value of insecticides, pesticides and weedicide
7. Irrigation charges.
8. Depreciation on farm implements
9. Interest on working capital.
10. Land revenue paid to government.

COST A2 = Cost A1+ Rent paid for leased in land, if any

COST B1 = Cost A1 + Interest on value of owned fixed capital assets.

COST B2 = Cost B1 + Rental value of owned land less land revenue

COST C1 = Cost B1 + Imputed value of family labour.

COST C2 = Cost B2 + Imputed value of family labour.

COST C3 = Cost C2 + 10% of Cost C2 on account of managerial functions performed by the farmer.

Rates of Returns over Different Cost Concepts

Gross Income: Yield of main product (in qt./kg) x their prices (Rs.)

Net Income : Gross Income – Cost C.

Farm Business Income:Gross Income – Cost A2

Farm Investment Income: Farm business income-Imputed value of family labour

Family Labour Income : Gross Income – Cost B

Cost of production: The cost of production was worked by the following formula:

$$\text{Cost of production/qt} = \frac{\text{Cost of cultivation Rs/hectare}}{\text{Quantity of main product qn/hectare}}$$

Benefit-Cost ratio:

It is the ratio between input and output, and computed by dividing value of total output by value of total input cost.

B-C Ratio = O/I

Where,

I = Total input cost

O = Gross Income

RESULTS AND DISCUSSION

Table 1 indicated that input used pattern for potato cultivation. The overall total working capital on sample farms were found to be Rs. 32900.83 while the interest on working capital Rs .493.32 and fixed cost Rs. 3312.48 the total cost observed on sample farms Rs . 48082 / hectare. The higher expenditure increased on seed cost Rs. 13168.88 fertilizer and manure Rs 3976.96 per hectare. Per hectare costs and returns for potato crop on different size groups of farms are presented in Table - 4.7, per hectare cost C_2 worked out to be Rs. 41821.74 On marginal, Rs. 46875.20 on small and Rs. 49339.21on medium farms with on an average of Rs. 43711.14. The table reveals that negative relation of cost A_1 and cost B_2 with farms size. This was because of the fact that use of variable inputs and investment cost decreased with the increase in farms size. Cost C_3 varied inversely with the farm size because of increasing use of family labour on small size group of farms. Per hectare gross income came to Rs. 164500.18 on average farm. Per hectare gross income was more on marginal farms that that of small and medium farms, primarily because of more use of variable inputs by the farmers that the latter. On an average farm, net income, family labour income, farm investment income and farm business income worked out to be Rs. 116417.96, Rs. 123974.10, Rs. 126147.14 and Rs. 134096.67, respectively.Cost of production per quintal of potato was computed to Rs. 185.20 and varied in the range of Rs. 206.66, Rs. 216.14 and Rs. 193.13 The inverse relationship of the ratio of benefit to cost A_1 and cost B_2 as well with the farm size as observed

Table - 1 : Cost of Cultivation of Potato on Sample Farms [rs. /ha]

S. No.	Component of investment	Size of group farms			
		Marginal	Small	Medium	Average
1	Human labour	7894.80	8489.95	9422.00	8175.00
A	Family labour	3362.50	2195.70	2280.30	2985.07
B	Hired labour	4532.30	6294.25	7141.70	4736.70
3	Machinery charges	6120.00	4500.00	5000.000	5630.40
	Irrigation	1500.00	1100.00	1650.000	1417.50
4	Seed/ tuber	12372.20	14295.30	16096.00	13168. 88
5	Manure and fertilizer	4290.00	3060.21	4091.25	3976.96
7	Plant protection	520.00	540.00	600.00	532.00
8	Total working capital	32697.00	31985.46	36859.25	32900. 83
9	Interest on working capital	490.45	497.78	522. 88	493.32
10	Rental value of land	7000	7000	7000	7000
11	Interest on fixed capital	1634.29	7391.96	4927.08	3312.48
12	Sub total	41821.70	46875.20	49339.21	43711.11
13	10% cost managerial of sub total	4182.17	4687.25	4933.92	4371.11
Grand Total		**46003.91**	**51562.42**	**54273.13**	**4**8082.25

Table - 2 : Measures of Per Hectare Costs and Returns of Potato

S. No.	Particulars	Size of sample farms			Overall average
		Marginal	Small	Medium	
1	CostA_1/A_2	29824.95	30245.54	35131.83	30403.51
2	Cost B_1	31459.24	37637.50	40058.91	33715.96
3	Cost B_2	38459.24	44637.50	47058.91	33715.96
4	Cost C_1	34821.74	39833.20	43392.10	33281.06
5	Cost C_2	41821.74	46875.20	49339.21	43711.14
	Cost C_3	46003.91	51562.72	54273.13	48082.25
	Gross income	163937.40	164670.00	168237.00	164500.18
	Net income	117933.53	113107.28	113963.87	116417.96
	Family labour income	125478.16	120032.50	121178.09	123974.19
	Farm investment income	126567.78	127499.24	125890.95	126147.14
	Farm business income	134112.45	134424.46	133105.17	134096.67
	Cost of production	185.20	206.66	216.14	193.13
	Yield [q/ha]	284.39	249.50	251.10	248.90
	Output-input ratio				
	On the basis of A_1/A_2	1:5.49	1:5.45	1:1.74	1:5.41
	On the basis of B_1	1:5.21	1:4.37	1:4.19	1:4.90
	On the basis of B_2	1:4.26	1:3.67	1:3.59	1:4.60
	On the basis of C_1	1:4.22	1:4.13	1:3.40	1:4.94
	On the basis of C_2	1:3.91	1:3.51	1.3.35	1:3.79
	On the basis of C_3	1:3.56	1:3.20	1:3.09	1:3.42

farm the table was mainly because of the positive associate on of variable inputs and investment cost with the farm size.

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CONSUMER BUYING BEHAVIOUR TOWARDS ONLINE FOOD DELIVERY SERVICES IN JAMMU CITY OF J&K STATE

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ABSTRACT

The recent improvement of the internet has increased the e-commerce industries everywhere in India. Online food delivery is highly popular these days since it provides a single window from which a variety of food can be ordered from a wide range of restaurants. There are many different eateries that provide their best offers and affordable prices while delivering food via online services. Restaurant business has expanded as a result of this. Additionally, it has led to a boom in the business and increased popularity of online food delivery services in India. Zomato, Swiggy, Pizza Hut, and Dominos are major players in the area. Through their smartphone applications, they have established an online food delivery system. These applications include meal menu layouts from all the nearby eateries, together with information about their prices and special offers. People can easily and hassle-free purchase their favourite meals from their favourite restaurants and have them delivered right to their door for a nominal delivery fee. The primary objective of this study is to examine the buying behaviour of consumers who use food delivery apps to place orders in Jammu city.

Keywords : *Online food delivery, Buying behaviour, meals services, smartphone apps and restaurants*

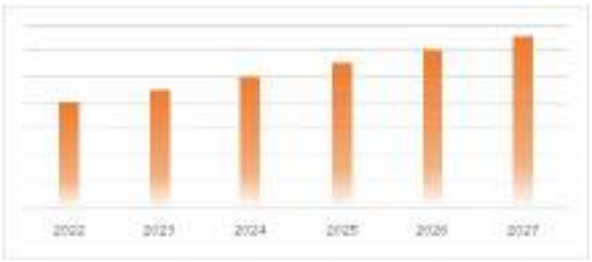
Introduction

The services sector is the largest sector of India. Gross Value Added (GVA) at current prices for the services sector is estimated at 96.54 lakh crore INR in 2020-21. The services sector accounts for 53.89 per cent of total India's GVA of 179.15 lakh crore Indian rupees (Ministry of Statistics and Programme Implementation, 2021). The rise of digital technology is serving in reshaping different industries. The greater than before use of technology increases the number of people linking the digital sector. Even Consumers are habitual to shopping or even ordering online through different apps or websites, with utmost ease and precision, expecting the same experience that customers would get from the outlet itself. So for matching up with the customer's expectations, food apps are providing increased facilities and services to them. The recent development in the Internet era has improved the e-commerce industries in a country like India. E-commerce development has made online food ordering services flawless for people who want to

get food delivered wherever they need. Technology has played a vital role in revolutionizing the food delivery service from phone-based to online ordering to satisfy consumers' ever-changing demands, making its way to the top. Nowadays, the business of food delivery services is one of the fastest rising segments of e-commerce. Convenience is the prime factor to the consumers, as to place an order is as simple as few clicks on any mobile device. Technological dependency, convenience and less time taken for the food to be delivered aids as a good reason for the consumers to choose the services offered by the online food ordering and delivery service portals. Digital technology has just started growing; it will continue to grow at a rapid rate and with the effect of this so will the various other industries, including the food delivery industry.

Online food delivery assists individuals in ordering and receiving the desired food products at the doorstep. It involves browsing the website or application, selecting from a wide variety of cuisines available and making the payment through different methods. The website/application updates the user about the expected duration of food preparation and delivery. These features, in confluence with attributes such as ease, speed and precision of delivery, are increasing the demand for these services in India. The Indian online food delivery market is expected to exhibit a CAGR of 28.9% during 2022-2027(Figure I).

India Online Food Delivery Market Size, 2022-2027 (in US$ Billion)



Source: www.imarcgroup.com, 2022

The market is currently witnessing growth on account of the increasing access to high-speed internet facilities and the boosting sales of smartphones. This, in confluence with the growing working population and inflating income levels, is propelling the online food delivery market growth in India. Although the players are mainly concentrated in the urban regions of the country, with Bangalore, Delhi and Mumbai representing the three largest markets, vendors are now also targeting smaller cities, as they have strong growth potential. Moreover, the rising trend of the on-the-go food items and quick home delivery models that offer convenience, ready-to-eat (RTE) and cheaper food delivery options are escalating the demand for online food delivery services in the country. Pertinently people prefer mobile apps over websites due to the user friendly interface (Figure II).

India Online Food Delivery Market Share, By Platform Type (in US$ Million)

www.imarcgroup.com, 2022

There are various apps in the Indian market that provide food with delivery service like Swiggy, Zomato, Food Panda, Uber Eats, other fast food apps such as Pizza Hut, Dominos etc.

Table - 1 : The Various Food Apps Available in India

Name of the Application	Country of Origin	Services Provided		Total No. of outlets/ restaurants/ stores/ centers	Delivery Charges levied or not
		Home Delivery	Availability of Online Menu		
Food Panda	Singapore	Yes	Yes	12000 Restaurants	Yes
Zomato	Portugal	Yes	Yes	10000 Restaurants	No
Beercafé	India	No	Yes	33 Restaurants	No
Box8	India	Yes	Yes	60 Stores	Yes
Faaso's	India	Yes	Yes	125 Centers	No
Dominos	India	Yes	Yes	800 outlets	No
Justeat	Denmark	Yes	Yes	2000 Restaurants	No
Swiggy	India	Yes	Yes	5000 Restaurants	Yes
Pizza Hut	US	Yes	Yes	1300 Outlets	No

MATERIALS & METHODS

To achieve the objectives of the study, the following steps were undertaken:

- **Data Collection and Analysis**

The data has been collected primary and secondary sources. Primary data includes information collected through questionnaire based on attitude and perception of customers using food delivery apps in Jammu region of Jammu and Kashmir. Secondary data included collecting information websites, journals related to brand and advertisement, newspapers, magazines etc. The sample size for the study was 100 consumers of Jammu region of Jammu and Kashmir. After collecting the data the result were analyzed by using descriptive statistics, percentage analysis. Percentage refers to a special kind of ratio. It is used to make comparison between two or more series of data. They can be used to compare the relative items, the distribution of two or more series of data, since the percentage reduces everything to a common base and there by allow meaningful comparisons to be made.

Percentage = (x/y) X (100/1)

Where x = number of respondents respond

y = total number of respondents

Garret Ranking Technique was also used to rank the various problems by consumers pertaining to online food delivery.

RESULTS AND DISCUSSION

To understand the behaviour of customers regarding usage of food delivery apps, socio-economic characteristics of the customers were studied. They are the important variables as they decide the consumption pattern and customer behaviour regarding these apps. Generally it is believed that, as the income, age and education of the customer varies impact the usage pattern of mobile apps. The following Table 1 and Figure III represents the socio-economic pattern of the selected sample.

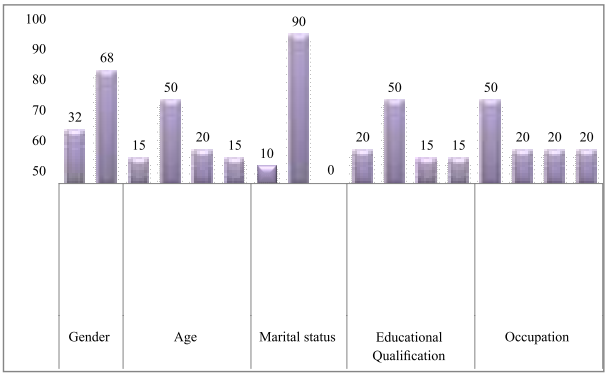


Figure III. Demographic details of the respondents

Table - 2 : Demographic details of the respondent

Demographics		Frequency	Percentage
Gender	Male	32	32
	Female	68	68
Age	Upto18	15	15
	18-25	50	50
	25-40	20	20
	40 and above	15	15
Education	Undergraduate	20	20
	Graduate	50	50
	Post Graduate	15	15
	Doctorate	15	15
Marital Status	Married	10	10
	Unmarried	90	90
	Divorced/ widowed	0	0
Occupation	Student	50	50
	Employed	20	20
	Unemployed	10	10
	Own business	20	10

The responses of the customer about the usage and the factors affecting usage were tabulated and analyzed to understand their behaviour.

A. Usage of internet in consumer's daily life

Table 2 represent the usage of internet in consumer's daily life. Out of 100 respondents 40.00 per cent of the respondents said that they use the internet more than 4hours/day.

Table - 2 : Usage of internet in consumer's daily life

Usage of internet in consumers daily life	Frequency	Percentage
less than1hour/day	5	5
2-3 hours/day	20	20
3-4hours/day	35	35
More than 4 hours/day	40	40

B. Most Preferred Online Food Delivery Service Portal

Table 3 represents the most preferred online food delivery service portal of the respondents. 57.00 per cent of the respondents said that they mostly preferred Zomato app followed by Domino's, Swiggy and Pizza Hut.

Table - 3 : Most Preferred Online Food Delivery Service Portal

Application	Frequency	Percentage
Zomato	57	57
Swiggy	17	17
Pizzahut	4	4
Dominos	22	22

C. Mode of advertisement influenced the consumers for food delivery app

Table 4 represents the mode of advertisement for food delivery apps. 50.00 per cent of the respondents said that internet influenced them for food delivery apps, followed by mobile, television, radio, word-of-mouth and newspaper.

Table 4: Mode of advertisement influenced the consumers for food delivery app

Application	Frequency	Percentage
Radio	10	10
Newspaper	2	2
Internet	50	50
Television	10	10
Mobile	23	23
Word-of-Mouth	5	5

D. Most preferred meal from online food delivery service

Table 5 represents the most preferred meal consumer order from online food delivery apps. Out of 100 respondents, 69.00 per cent preferred snacks, followed by dinner, lunch, and then breakfast.

Table - 5 : Most preferred meal from online food delivery service

Meal prefer	Frequency	Percentage
Breakfast	2	2
Lunch	10	10
Dinner	19	19
Snacks	69	69

Frequency of using food delivery apps

Table 6 represents that frequency of the consumers for using food delivery apps. It was found out that 85.00 per cent of the respondents said that they use the food delivery apps sometimes, followed by 12.00 per cent who said that they use the food delivery apps on the regular basis, and 3 per cent of the respondents said that they never use food delivery apps.

Table - 6 : Frequency for using food apps

How often use the application	Frequency	Percentage
Sometimes	85	85
Regular	12	12
Never	3	3

E. Range of ordering food items

Table 7 represents the range of ordering food items, Out of100 respondents the 40 respondents i.e. (40.00 per cent) said that they spend Rs.100-300 on ordering food items followed by the 26 respondents i.e. (26.00 per cent) said that they spend Rs300-500 on ordering food items, followed by the 21 respondents i.e.(21.00 per cent) said that they spend Rs.500-1000 on ordering food items, followed by11 respondents i.e. (11.00 per cent) said that they spend below 100 on ordering food items, followed by the 2 respondents i.e.(2.00 per cent) said that they spend above Rs.1000on ordering food items respectively.

Table - 7 : Range of ordering food items

Order Range (INR)	Frequency	Percentage
Below100	11	11
100-300	40	40
300-500	26	26
500-1000	21	21
Above1000	2	2

***F.* Method of Payment of Respondents**

Table 8 represents that the payment method of respondents. Major proportion of the respondents i.e., 62.00 per cent consumers preferred Cash on Delivery.

Table - 8 : Method of Payment of Respondent

Mode of payment	Frequency	Percentage
Cash on delivery	62	62
Netbanking	19	19
Payment portals	19	19

CONCLUSION

The research concluded that Zomato has been in the first position in online food delivery service provider followed by Swiggy, Pizzahut, Dominos. The highest number of respondents i.e. 50 (per cent) said that internet is the best mode of advertisement which influenced the consumers for food delivery app. The majority of the respondents i.e. 73 (per cent) said that online payment mode of the applications are safe and secure. The highest number of the respondents i.e.,62(per cent) said that the best mode of payment is cash on delivery. Also, the study found that the majority of the respondents i.e., 69 (per cent) said that they mostly prefer to order

snacks from online app. Also the study found that the majority of the respondents i.e. 40 (per cent) said that they use the internet more than 4hours/day. The study revealed that the majority of the respondents i.e., 85(per cent) said that the frequency of using the applications are sometimes but not on the regular basis. The majority of the respondents i.e., .27 (per cent) said that the highest range of ordering food items lies between100-300.Using garret ranking technique, external influence was ranked as 1st factor influencing buying behaviour towards online food delivery services followed by perceived use of ease ranked 2nd & trust was ranked 3rd. Using garret ranking technique time saving, was ranked 1st related to the features which attract the most to consumers towards online food delivery services followed by faster delivery ranked 2nd & discount of food was ranked 3rd, variety of products was ranked as 1st, factor influenced consumers perception for selecting medium for online food delivery services followed by quality of services ranked 2nd and ease of payment was ranked 3rd, technical issues, was ranked 1st related to the factors which act as a constraints while using online food delivery services followed by reach of delivery ranked 2nd & unavailability of internet was ranked 3rd.

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DIGITAL MARKETING FOR YOUTH OF INDIA : CURRENT STATUS AND FUTURE OPPORTUNITIES

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ABSTRACT

Now days Digital Marketing is a booming career options today in India. With striking features like cost-effectiveness, instant response, flexibility, convenience, effectiveness digital marketing is making a strong impact in the world of marketing and advertising. According to data available, total advertising industry is worth 7.94 billion dollar in India. Out of which 1.78 Billion dollar is getting spend on digital marketing including mobile advertisements. It was continue to increase at a growth rate of 26% in 2019 and now Indian advertising industry is continue to increase about 33.5 percent at present. People are spending a lot of time on mobiles and social media. By the current year data issurprising with over 20 lakh jobs opportunities are providedby the industry in the digital marketing domain. The internet industry in India is likely to reach 250 billion dollar by 2020 with the 7.5 per cent contribution in GDP in service sector. The number of internet users in India is expected to reach 900 million by 2025. Since India's cost competitiveness in providing digital services, it is approximately 3-4 times cheaper than the United States of Americe (USA). India has come out on top with the highest proportion of digital talent in the country at 76 per cent compared to the global average of 56 per cent. The role of digital marketing amid the COVID -19 pendemichas become more and more important all the time. As a result there is rising interestand investment it digital marketing that span the globes we have never seenthis much profound respect and understanding digital marketing before. The future of digital marketing looks brighter than ever and it only continues to gain more and more momentum as times goes on.A study done by eMarketer in February 2019 and found that online spend had officially exceeded that of offline for the first time and now accounted for half of all global ad spend. The same study predicted that by 2023 digital ad spend will account for two third of global media spend, a market estimated to be worth $ 333.25. Given that at the turn of the 21st century digital accounted for just 3% of global spend its clear to see that the shift we have been observing is ramping up in pace. Lockdown has not just seen changes in the internet used for communication through. The retail sales index time series (DRSI) published a dataset showing internet sales as the percentage of total retail sales ratio in percent in June 2021.The uptick in online sales shown from spring 2020 is remarkablethat the value of internet sales as the percentage of total retail sales went from 18.9% in February 2020 to 32.8% in May 2020 with no stallin site going in to the summer. Interestingly Hermes, the delivery and logistics company, specialized in delivering on line purchases', has announce that they will be recruiting more than 10000 new team members in a direct response to the increase in online shopping during lockdown. To see the importance of digitization, The Digital Indiaprogramme was launched over a year ago in 2015. The program has now moved from the planning phase towards execution. Due

to Digital India programme the IT industry will get tremendous growth in coming years andalso Indian digital industry is expected to grow to US 350 billion dollar by 2025.It will provide approximate 5-8 lakhs digital jobs in marketing and content development continuously by 2030.

Keywords : *digital india, digital jobs, digital growth, digital marketing*

INTRODUCTION

Digital Marketing is the promoting of products over the internet or any form of electronic media. Digital Marketing is the use of digital channels to promote or market products and services to targeted consumers and businesses[9, 12, 13]. Technological advances have resulted in considerable attrition of the customer-base of traditional marketing agencies & departments. People have moved on to tablets, phones, and computers, which are the areas where digital marketers have gained the most ground. In the world where over 3.6 billion people wereusing socialmedia in 2020 on a regular basis. A number projected to increase to 4.41 billion in 2025.Every working professional is expected to be familiar with at least the core tenets of Digital Marketing.

Very soon, traditional marketing platforms will disappear, and the digital market will completely take over. The Indian advertising industry has evolved from being a small-scaled business to a full-fledged industry. The advertising industry is projected to be the second fastest growing advertising market in Asia. It is estimated that by 2018, the share of digital advertisement spend in India's Gross Domestic Product (GDP) will be around 0.45 per cent[10, 12]. In 2020, the Indian advertizing industry was valued over 564 billion Indian rupees and it was projected to reach up to 700 billion rupees by 2021.The industryhad grown at a rate of11.59 percent in the given time frame, and was poised for future growth on back of rapid digitalization in the upcoming years.

The Indian government has given tremendous support to the advertising and marketing industry. Print contributes a significant portion to the total advertising revenue, accounting for almost 41.2 per cent, whereas TV contributes 38.2 per cent, and digital contributes 11 per cent of the total revenue. Outdoor, Radio and Cinema make up the balance 10 per cent of the total market size[11,13].India's digital advertisement market is expected to grow at a compound annual growth rate of 33.5% to cross the Rs 25,500 crore in 2020[18]. The Internet's share in total advertising revenue is anticipated to grow twofold from eight per cent in 2013 to 16 per cent in 2018[13]. Online advertising, which was estimated at Rs 2,900 crore in 2013, could jump threefold to Rs 10,000 crore in five years, increasing at a compound annual rate of 28 percent[15].

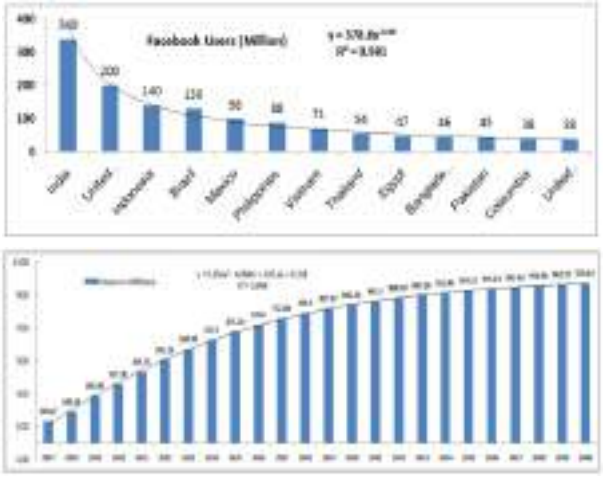

Figure - 1 : Trend of Indian Facebook Users

Source: Statista Research Department Sep. 10, 2021

History of Digital Marketing

In 1993, the first clickable banner went live, after which Hot Wired purchased a few banner ads for their advertising. This marked the beginning of the transition to the digital era of marketing. Because of this gradual shift, the year 1994 saw new technologies enter the digital marketplace was launched by Yahoo. Yahoo received close to 1 million hits within the first year20. This prompted wholesale changes in the digital marketing space, with companies optimizing their websites to pull in higher search engine rankings. India-MART B2B marketplace was established in India in 1996. Microsoft launched the MSN search engine and Yahoo brought to the market Yahoo web search18. Two years later, the internet bubble burst and all the smaller search engines

were either left behind or wiped out leaving more space for the giants in the business. The digital marketing world saw its first steep surge in 2006, when search engine traffic was reported to have grown to about 6.4 billion in a single month15.

Sensing an opportunity, Google began to expand, introducing such products as AdWords which are 3 line ads that show up at the top or to the right of search engine results and AdSense which is a cost-per-click advertising scheme. In time, Google realized the value of analyzing the content they received and then target ads based on the interests of the users and thus became a major player in the world of business17. Then came Web 2.0, where people became more active participants rather than remain passive users. Web 2.0 allowed users to interact with other users and businesses. Labels like 'super information highway' began to be applied to the internet. As a result, information flow volumes including channels utilized by digital marketers- increased manifold and by 2004. Soon, social networking sites began to emerge20. In 2007 Flipkart was established in India.

My Space was the first social networking site to arrive, soon followed by Facebook. Many companies realized all these fresh new sites that were popping up were beginning to open new doors of opportunities to market their products and brands17. It opened fresh avenues for business, and signaled the beginning of a new chapter to business. With new resources, they needed new approaches to promote their brands & capitalize on the social networking platform.

Present Status of Digital Marketing

India's telecommunication network is the second largest in the world by number of telephone users both fixed and mobile phone with 1179.49 million subscribers as on 31 January 2021. The digital journey is one of exuberance. The country had the world's second largest internet population at over 749 million users in 2020. Of these, 744 million users accessed the internet via their mobiles phones. The mobile internet is basic factor that is responsible for the growing digital marketing industry in India. Growing trend of startups is another reason that plays noteworthy role in creating a great scope of digital marketing in India.

It is highly economical and equally powerful way of conversion-oriented marketing1, 4. All the digital marketing exercises can also be quantified through powerful digital marketing tools like Google Analytics, Google Webmaster, etc. that make it one of the most result-oriented modes of marketing5, 8. Other industries are struggling with a growth rate of 5 to 10%, while digital marketing industry was booming high with 41% growth rate. Digital marketing industry is worth 68 billion dollar. Last year the advertising via mobile phones and tablets rose 200 percent, to 6 billion dollar. This market is estimated to touch 7.8 billion dollar soon2, 3. This rise is leading for high demand for professionals skilled in Digital Marketing.

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Job Opportunities in Digital Marketing

As we have stated already the other industries are struggling while digital marketing industry is booming with high growth rate. The growth of digital marketing is nothing less than magical. Digital marketing is a skill set which invariably helps everyone who is on internet in using the power of internet to their advantage by learning to create, promote effectively[3, 8]. Digital marketing opens the door to us for a wide array of opportunities. Digital marketing is hottest skill in today's business promotion. But the most remarkable point is that this growth rate is not going to be stagnant in the coming years[2,9]. In the year 2016 by surprising figure with over 1.5 lakh jobs opportunities are provided by the industry in the digital marketing domain. Rise in mobile-phone penetration and decline in data costs will add 500 million

new internet users in India over the next five years so that digital payment in India is expected to grow from 32 per cent in 2013-14 to 62 percent in 2017-18 in terms of volume of transactions[13,14,16,19]. The internet industry in India is reached 250 billion dollar in 2020 with the 7.5 per cent contribution in GDP.

The number ofinternet users in India wasexisted 730 million in 2020 and expected to reach 900 million by2025[11, 12, 18]. So the industry is generated more than 20 lakh jobs in the year 2020. India had about 340 million Facebook users as of July 2021 and this number is an indication that almost 50% of the Internet-using population in India wants to network. Business to Business e-commerce market had reached 700 billion dollar by 2020 whereas the business to consumer e-commerce market had reached 102 billion dollar by 2020[14, 16]. The current growth rate in digital marketing Industry is 40%. There is 25,200 crore expected share of advertisement and promotion budget which had allocated to internet advertisement and promotion by the year 2020[5,12,17]. Since India's cost competitiveness in providing digital services, which is approximately 3 to 4 times cheaper than the US, India has come out on top with the highest proportion of digital talent in the country at 76 per cent compared to the global average of 56 percent.

Figure - 2 : Internet users in India (Millions per year)

Figure - 3 : Total Retail Sale(USD Billion

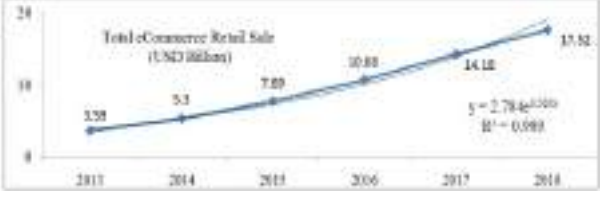

Figure-4 : Total e Commerce Retail Sale (USD Billion)

The average salary paid to Digital Marketing professionals is quite high as per industry standards and the industry is soon becoming an extended arm of the marketing division of every company, thereby leading to a surge in demand for digital marketing professionals. Hence the future of a career in this industry definitely looks promising.

Digital Marketing & Dimensions of Jobs

There is a significant gap in demand and supply of digital marketers today. Digital or social media as a marketing subject is not covered in depth in most professional courses. Digital marketing is empowering to compete against larger, conventional players at a far lower cost[1, 5]. Small mom-and-pop stores have also jumped on the bandwagon with many messaging tools for customer communication, offers, and sales[2, 3]. Unlike a few years ago, it is a bit of a challenge to stay up to date in the digital marketing industry today

It is very surprising that this is the state of affairs in the country because the opportunities for a digital marketing professional are huge in India right now. This is not just in terms of career growth opportunities, but in monetary terms as well. A fresh graduate can easily obtain a role with a salary close to 25K per month to 6 lakhs per annum, while experienced professionals can command remunerations in the range of **2**0 lakhs – 75 per annum[14,19]. Mobile Apps & plugins have simplified marketing. It's just identifying the right apps to create amazing content. Creating relevant and timely Content is one of most important skill in 2016[18]. Some most desired profiles in digital marketing field[1, 15, 18, 19] are*Digital Marketing Manager, Content Marketing Manager, Content Writers, Inbound Marketing Manager, Social Media Marketing Experts/Specialists, Search Engine Marketers, SEO Executives, Conversion Rate Optimizer, Copy Writers.*

The Indian advertising industry has evolved from being a small-scaled business to a full-fledged industry. The advertising industry is projected to be the second fastest growing advertising market in Asia after China[2,3]. It is estimated that by 2018, the share of ad spend in India's Gross Domestic Product (GDP) will be around 0.45 per cent. With technology developing every day, anybody has to continuously develop our digital marketing skills so that their career keeps growing. It

provides you with various career options. If we love coding, we can go for web designing or if we are a born writer, go for content marketing and so on[4,6].

CONCLUSION

Digital marketing is growing with a rapid pace not only in India but throughout the world as well. While all other Industry are struggling with a growth rate of 5-10%, Digital marketing industry is booming high and already achieved growth rate of 30% last year and estimated growth for year 2016 is 40% and the most important part is that growth rate is not going to be stagnant in coming years. With a penetration rate of 34.5% India is a world 2nd most internet surfing population so it's clear there is still lot to go. The growth is rapid in this field and still a long way to go with higher pace that's the reason every fresher's and professionals looking to build their career in digital marketing. The advertising and marketing sector in India is expected to enjoy a good run. Growth is expected in retail advertisement, on the back of factors such as several players entering the food and beverages segment, e-commerce gaining more popularity in the country, and domestic companies testing out the waters.

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APPLICATION FOR THE MEMBERSHIP OF SBSRD ALLAHABAD

(Registered under Soc. Reg. Act –1860)

Regd. Office: 10/96, Gola Bazar, New Jhusi, Prayagraj, (U.P.), India

Membership type (Please tick): *Life ☐ Annual ☐

1. **Name (in capital)** .....
2. **Designation** .....
3. **Affiliation** .....
4. **Address** .....
   .....
5. **Date of Birth** .....

Photo

6. **Mobile/Phone Nos** .....
7. **Email ID** .....
8. **Website (if any)** .....
9. **Academic Field** .....
10. **Research Field** .....
11. **Experience** (in years) **a)** Research.....**b)** Teaching.....
12. **Honours/Awards** (Nos.) **a)** National.....**b)** International.....
13. **Fellowships** (Nos. only) **a)** National.....**b)** International.....
14. **Publications** (Nos. only)
    (i) Research Papers/Rev. Articles.....**(ii)** Books/Monographs.....
15. **Fee Details** .....

Declaration: I hereby declare that the Information furnished above is true to the best of my knowledge and belief and I am abiding by the rules of the Society of Biological Sciences and Rural Development, Allahabad.

Date:..... **Signature:** .....

MEMBERSHIP OF SBSRD, ALLAHABAD

Category	Indian
1. Annual	Rs. 500/-
2. Life	Rs. 4500/-
3. Institutional	Rs. 10,000/

The payment should be made through Demand Draft/E - Banking

favour of ***"Socity of Biological Sciences and Rural Development, (A/c No. 31105794798) Payable at State Bank of India, Jhusi Branch (IFSC Code SBIN 0005440), Prayagraj, U.P., India.***