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Reproductive Biotechnologies in Horses

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Advances in Reproductive Biotechnologies in Horses

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Reproductive biotechnologies in horses have advanced from artificial insemination (AI) and embryo transfer (ET) to oocyte transfer (OT), low dose deep intra uterine insemination, sperm sexing, intracytoplasmic sperm injection (ICSI), and nuclear transfer (cloning). This have been driven by the desire to: (1) get pregnancies in mares that would otherwise be infertile, (2) multiply certain genetic lines at faster rate, (3) study the biology of oogenesis, fertilization and embryonic development, and (4) provide material for other techniques, such as micromanipulation or genetic engineering (Coutinho, 2008). AI with fresh, cooled and frozen semen has been accepted by almost all the horse breed registries.

Recent advances in horse AI are sexing of sperm, low-dose deep intrauterine insemination (Buchanan *et al.,* 2000), and intracytoplasmic sperm injection (Grandahl *et al.,* 1997). Advances of mare reproduction included tools for hastening the onset of the breeding season besides other advances such as embryo transfer, oocyte collection and transfer, gamete intra fallopian transfer (GIFT) and cloning. Some of the techniques such as superovulation, in vitro fertilization (IVF) and cryopreservation were slower to develop in horses than in other species, mainly due to technical barriers e.g. failure to respond to super-ovulatory regimes and inability of sperm to penetrate the zona pellucida in-vitro. The economic value of horse with changing attitudes of breeders resulted in resurgence of interest and great developments especially in the area of cooled and frozen semen as well as embryo transfer. Uses of reproductive biotechnologies have benefitted reproduction in horses and the recent developments in this have great potential for understanding the biological processes, propagation and conservation of endangered breeds of horses.

1. MARKER ASSISTED SELECTION OF STALLIONS

Variations in protein bands of different molecular weight in horse seminal plasma indicate difference between individual sires (Zahn *et al*., 2006). Considerable variation occurs in cysteine-rich secretory proteins (CRISPs) among different stallions (Leeb *et al*., 2005) and an association of stallion fertility with polymorphism of the CRISP-3 gene (Hamann *et al*., 2007). Further analysis and definition of seminal plasma fractions and proteins responsible for the different cooling ability of individual stallions could have a key role for the development of new extender components. Genetic markers may be useful in selection of breeding stallions. Hamann *et al*. (2007) reported a significant association between a CRISP3-associated single nucleotide polymorphism (SNP) in stallions. Significant associations of single markers and haplotypes with least square means (LSM)-PRO and the embryonic and paternal component of breeding values support a role for inhibin beta A (INHBA) mutations in fertility of stallions (Giesecke *et al*., 2009a). Significant association was also found between fertility and a spermatogenesis associated 1 (SPATA1) related SNP (Giesecke *et al*., 2009b).

2. SEMEN CRYOPRESERVATION

Post-thaw spermatozoa motility and fertility vary greatly between stallions (Pal *et al*., 2011), and even among different ejaculates from the same stallion (Arangasamy *et al.,* 2008) which put limitation for commercial use of frozen-thawed semen in equine AI. Studies have been conducted to identify components of the seminal plasma or sperm that may be useful in predicting the freezability of stallion semen. Areas of potential research with frozen/thawed semen include determining biomarkers of fertility, developing cheaper devices for shipping semen, improved extenders, and tests for assessment of sperm damage. While glycerol remains the most common cryoprotectant for spermatozoa, there are harmful effects posed by its use, including membrane damage via an osmotic effect and disruption of the actin cytoskeleton (Garcia *et al.,* 2012). For this reason, alternative cryo-agents have been examined recently, including methyl formamide (MF) and di-methyl formamide (DMF) (Arangasamy *et al.,* 2014).

3. LOW DOSE DEEP INTRA UTERINE INSEMINATION

One of the recent trends in AI is use of much lower sperm numbers, that is, low-dose insemination (Brinsko, 2006). Instead of inseminating 400 to 800 million total spermatozoa into uterine body, 5 to 100 million sperm can be inseminated at the tip of the uterine horn near uterotubal junction (UTJ) (Brinsko *et al*., 2003). This is an attempt to minimize wastage of semen, particularly from older stallions that have limited sperm, and from stallions that have died. Other reasons include limited availability of frozen semen straws from a particular stallion and the use of sex-sorted spermatozoa. Low-dose insemination of equine sperm can be done either with a rectally guided flexible catheter or with the use of an endoscope.

4. SEX SORTED FROZEN-THAWED SPERM

Selecting the sex of an offspring offers advantages to the equine industry. For example, colts being preferentially used for dressage whereas, fillies are preferred for Polo competition. To date, the only repeatable method of selecting spermatozoa for chromosomal sex is the Beltsville sorting technology using flow cytometry (Garner, 2006). However, use of sex-sorted sperm in the horse industry is extremely limited because valuable stallions are too busy in the breeding season to provide fresh ejaculates for sex sorting. This technique does not appear to work on all stallions and requires that the stallion, mare, and sorting equipment be in near proximity for sexing. This is certainly an interesting area for researchers to improve frozen/thawed sexed semen and potentially develop other cheaper methods for sexing semen. In the last several years, the number of cows inseminated with sex-sorted frozen/thawed bull sperm has increased dramatically (Hutchinson and Norman, 2009). Although foals have been produced from sex sorted frozen/thawed stallion sperm, the fertility was extremely low (Lindsey *et al.,* 2002).

5. INTRACYTOPLASMIC SPERM INJECTION (ICSI)

Intracytoplasmic sperm injection (ICSI) has been used for the production of foals from stallions that have less than typical sperm numbers or from stallions that have died and a limited quantity of frozen semen is available (Squires, 2005). This technique allows older, sub fertile stallions to be used as breeding stallions and has also been used by several laboratories to produce embryos in vitro. Oocytes are retrieved from the donor mare 24 hours after hCG administration.

Those oocytes are then injected with one sperm for fertilization. Approximately 65% to 70% of the oocytes that are injected fertilize, and if these fertilized embryos are transferred, approximately 50% of those result in a pregnancy (Squires, 2009). Potential disadvantages are the high cost of sperm injection and the apparent increased embryonic loss.

6. CLONING

The first cloned foal was born in 2003 in Italy (Lagutina *et al.,* 2005). Since that time, there have been numerous clones that have been born and, according to Viagen (the only commercial company). Cloning is only a mechanism of helping the rich that have extremely valuable horses. A clone is not an identical replacement for the donor and there remain differences in gene expression between both. Female clones inherit some mitochondrial DNA from the oocyte donor (Carnevale *et al.,* 2005) and there will be some environmental influence from the recipient because all clones are being carried by recipients. However, using cloning to produce a stallion from a gelding or to replace a stallion may be of some value. Cloning in horses is under developmental stages where several laboratories and commercial entities are investigating the use of nuclear transfer technologies for production of cloned horses.

7. SUPEROVULATION

Superovulation can potentially increase the efficiency and decrease cost of embryo transfer by increasing embryo collection rates (Squires *et al.,* 2003). Superovulation also suggested as an essential requirement for other types of assisted reproductive technology in the horse, including oocyte transfer gamete intrafallopian transfer (Squires *et al.,* 2003). Unfortunately, techniques used successfully to superovulate ruminants, such as administration of porcine follicle stimulating hormone and equine chorionic gonadotropin have little effect in mare (Sirois *et al.,* 1992). The most consistent therapy used to induce multiple ovulations in mares has been administration of purified equine pituitary gonadotropins. Equine pituitary extract (EPE) is a purified gonadotropin preparation containing approximately 6% to 10% LH and 2% to 4% FSH. EPE has been used for many years to induce multiple ovulations in mares (Dippert *et al.,* 1992). Purified equine FSH product has become available commercially (Guillou and Combarnous, 1993).

8. OVUM PICK UP

The recovery of oocytes from the mare was first applied to the preovulatory follicle using different procedures, including laparotomy under general anesthesia, colpotomy, and aspiration using a long needle placed through the flank in the paralumbar fossa. However, these approaches were invasive and their efficacy was limited. The most practical, less invasive, efficient, and repeatable technique now used is the ultrasound-guided transvaginal follicular aspiration using a double-lumen, 12-ga needle (Carnevale *et al.,* 2005). This offers possibility of repeated recovery of biological substrates, i.e. follicular fluid, granulosa cells and cumulus-oocyte-complexes (COCs) from individual follicles (Wilhelm *et al.,* 2003). Oocytes can be collected from the pre-ovulatory follicle that has reached at least 35 mm in diameter, 24 hours after HCG injection with the donor showing signs of uterine edema.

9. OOCYTE TRANSFER

Oocyte transfer has been used to obtain pregnancies from valuable mares from which viable embryos cannot be obtained for transfer (Carnevale *et al.,* 1999). The first successful Oocyte transfer in the horse was done in 1988 (McKinnon *et al.,* 1988). However, high success rates for oocyte transfer were not demonstrated until Carnevale and Ginther (1995) obtained embryo development rates of 92% after transfer of oocytes from young donors in to young recipients. Since, oocytes are mechanically transferred into recipient's oviducts, the events associated with natural ovulation and fertilization can be altered. Oocytes can be removed from follicles at different stages of maturation or atresia. Immature oocytes can be collected from the follicles of live mares. The equine cumulus has a close and broad attachment to the follicular wall, however, with cumulus cell extensions into an underlying thecal pad (Hawley *et al.,* 1995). Oocyte retrieval from older mares can be as high as 80%, and those oocytes, when transferred into young recipients, can result in a 40% to 50% pregnancy rate (Carnevale *et al.,* 2005).

10. GAMETE INTRAFALLOPIAN TRANSFER (GIFT)

In this technique, sperm and oocytes are transferred into the oviduct of a recipient. A low number of sperm are required for GIFT; therefore, it is a potential method for obtaining offspring from stallions with low sperm numbers. The first successful GIFT in a mare was done in 1998 (Carnevale *et al*., 1999).

Insemination of recipients for sperm and oocyte transfer resulted in a further understanding of the interaction of sperm, oocyte and reproductive tract.

11. EMBRYO TRANSFER

Embryo transfer (ET) programs in horses aim to produce multiple foals from the same mare in one breeding season (Coutinho, 2008). Older mares and those with unsatisfactory reproductive performance are commonly used in ET programs. Mares that are competing are also candidates for ET programs (Squires *et al.,* 2003). The implementation of an ET program is not expensive compared with other advanced reproductive technologies. The standard method of embryo collection in the mare is a non-surgical transcervical uterine lavage (Squires *et al.,* 2003).

12. IN-VITRO FERTILIZATION (IVF)

In many domestic species, IVF has been successful in yielding live offspring as well as advancing research and application. This technique would be useful in mares that have fertility problems and are unable to provide embryo. It also provides embryo for culture, embryo freezing and laboratory test for evaluation of frozen semen. However, IVF in equines is known for its limited efficiency and lack of repeatability (Squires *et al.,* 2003). The first equine IVF was reported in 1989 (Bezard *et al.,* 1989), after that few reports of successful IVF have followed, and in most reports, fertilization rates were <20% (Squires *et al.,* 2003). Alternative methods for fertilization of equine oocytes have been developed, including oocyte transfer (Carnevale and Ginther, 1995) and ICSI (Hinrich *et al.,* 2005). Since these alternative methods are relatively efficient, continued work on standard equine IVF has been limited. Two major barriers of successful IVF are oocyte maturation and sperm capacitation. Cumulus can be partially removed to increase the fertilization of compact-cumulus oocytes using frozen-thawed, heparin-treated semen (Dell Aquila *et al.,* 2000).

13. EMBRYO CRYOPRESERVATION

The freezing protocol is similar that used for bovine embryos, and glycerol is the cryoprotectant. However, in horse, the size of the embryo and the developmental stage appear to be more critical for its survival after freezing and thawing than the type of cryoprotectants used (Squires *et al*., 1999). Between days 6 and 7, an acellular capsule is formed underneath the pellucid which may impair movement of the cryoprotectants to zona into the

embryo. Some pregnancies were reported after transfer of vitrified embryos (Hochi *et al*., 1994). The addition of 100 mM l-glutamine to glycerol solution has shown to improve the success of equine embryo transfer (Lagneaux *et al*., 1998). Pregnancy rates after transfer of conventional slow-frozen expanded blastocysts (>300–1100 mm), collected on day 8, are low (Moussa *et al*., 2005). It is thought that in larger to usual embryos, thickening of embryonic capsule impedes penetration of cryoprotective agents (Legrand *et al*., 2002). Reasonable pregnancy rates (50%) can be obtained for smaller equine embryos. Reduction in volume of blastocoelic fluid by aspiration combined with micro infusion of cryopreservative before vitrification, using highly viscous cryoprotectants and a very rapid cooling rate demonstrated more successful pregnancies after transfer of equine expanded blastocysts (Scherzer *et al*., 2008).

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Importance of Drought Power and Muscle Fatigue Assessment in Livestock

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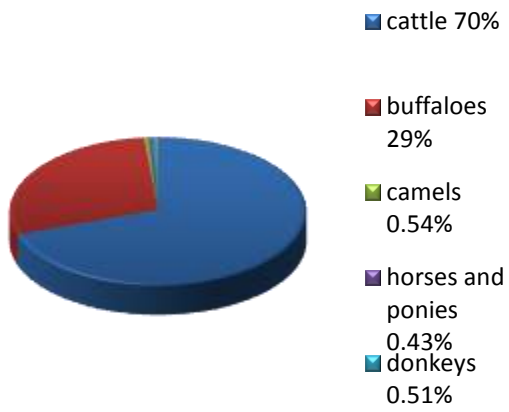
Draught animal power in agriculture

The importance of draught animal welfare can be viewed from a number of different perspectives: economic, ecological, social, cultural, and emotional or affective. Draught animals have contributed a great deal to human civilisation. Even in this century, when petroleum-based mechanical and electrical equipment has replaced animals in advanced countries, draught animals still play an important role in certain developing countries, and will continue to do so for many years. Despite the past and present contribution of draught animals to mankind, the care of these animals is currently neglected, with the result that owners of draught animals are incurring losses, and society suffers accordingly. Therefore, measures are required to foster care and welfare of draught animals. Greater care of draught animals will also improve human welfare.

Draught animal power is the (DAP) is the most appropriate and the most economical source of power in rural areas and more readily available throughout the country. The renewable DAP is an outstanding example of mass level application of appropriate technology by the millions of marginal and small farmers and it has no equal. In India 65% area sown is ploughed by draught animals and 20% by tractors. India has a stock of about 65 millions draught animals, thus saving fossil fuel worth60 billion annually.

Traditionally, draught animals have been used in India for field operations, transport and agro-processing. The value produced by draught animals in India would be over Rs. 1000 billion, whereas mechanical sources of agricultural power depend on fossil fuel that has only limited life.

Current Draught Animal Power in India



Muscle Fatigue

Muscles have the process of contraction uses ATP as fuel. Depending on the level of ATP is supplied by aerobic and anaerobic processes in the muscle. Draught animals working at the lower rates generally, do not exceed the aerobic limits to accelerating to heavy work involves both process as higher rates. Muscle fatigue during sustained work or after a burst of activity has been attributed to either accumulation of waste products or depletion of energy mediating processes. When all muscle energy is exhausted, the muscle is unable to expand the small amount of ATP required for relaxation but this may happen only in extreme cases after physiological contracture or after a burst of muscular activity. In general, this does not happen in draught animals and energy in form of ATP is supplied continuously by both aerobic and anaerobic processes. The lactic acid produced in muscle as a result of anaerobic breakdown of glycogen is not removed quickly and contributes to fatigue by lowering pH and affecting enzymatic processes. The lactic acid content in muscle in bullocks performing heavy work over prolonged hours in heat has indicated that fatigue is more probably related to accumulation of lactic acid and inadequate neutralization in muscle than to energy exhaustion.

In coordination and movement inhibition observed in bullocks and buffaloes may be attributed to neuromuscular fatigue which may occur prior to contractile fatigue or as a results of exhaustion of calcium or energy in the muscle. Since the physiological processes are complementary within limits, the commissioning of various processes protects muscle from irreversible damage or physiological breakdown. Work animals can be declared fatigued on the basis of various physiological and behaviour manifestations and rest pauses may be essential to protect the animal from any health problems related to overstress.

Animal fatigue-assessment

Intensity of work, proportionally loads cardiovascular, pulmonary and thermoregulatory systems, which do not fully coordinate and as a results alter

'chemical milieu' at the cellular level leading to a decreased work output. The sequence of events and exact mechanism which leads to onset of fatigue in working animals is not known. Upadhyay and Madan (1985) developed a fatigue score based on physiological reactions, distress symptoms and behavioural manifestation. The fatigue score totalled 40 points, out of which animals were to be evaluated; animals attained a value of 20 points were declared fatigued.

Table 1: Fatigue score card for working bullocks and buffaloes Work rest cycle

Parameter	Score scale					Total
	1	2	3	4	5	
RR(breaths/min	Ro+15	Ro+30	Ro+45	Ro+60	Ro+75	5
HR(beats/min)	Ho+10	Ho+20	Ho+30	Ho+40	Ho+50	5
Rectal Temp. (ºC)	ºTo+0.5	ºTo+10.	ºTo+1.5	ºTo+2.0	ºTo+2.5	5
Frothing	First appearance	Dribbling of saliva starting	Continuous dribbling	Appearance Of froth on upper lip	Full mouth frothing	5
Leg uncoordination	Strides uneven	Occasional Dragging of feet	Movement of legs uncoordinated and dragging of feet	Movement of legs uncoordinated and dragging of feet	Unable to move because of uncoordination	5
Excitement	composed	Disturbed	Nostrils dilated and bad temperament	Movement of eye wall prominent with excitement	Furious and trying to stop	5
Inhibition of progressive movement	brisk	Free movement	Slow walking	Very slow	Stop walking	5
Tongue protrusion	Mouth closed	Occasional opening of mouth	Frequent Appearance of tongue	Continuous protrusion of tongue	Tongue fully out	5

** Ro, Ho, To represent initial respiration rate, heart rate and rectal temperature, respectively.*

Source : Upadhyay & Madan (1985)

Table 2: The range of fatigue parameters of draught animals

Animal	Respiration Rate *breath/min*	Heart beat rate *beats/min*	Body temperature *ºC*
Oxen	Ro+ (15 - 75)	Ho+ (10 - 50)	To+ (0.5 + 2.5)
Buffaloes	Ro+ (40 - 50)	Ho+ (10 - 33)	To+ (1.8 + 3.2)
Camel	Ro+ (04 - 08)	Ho+ (12 - 18)	To+ (0.7 + 1.7)
Donkey	Ro+ (15 - 50)	Ho+ (15 - 48)	To+ (1.0 + 3.0)

Source: Annual Reports of AICRPs on Utilization of Animal Energy. Central Institute of Agricultural Engineering, Bhopal.

No specific research attempts have been made to indicate the suitable work rest cycle, and number of rest pause (s). The disjointed and variable information available from farmers based on practices followed in routine at farm have been considered to furnish guidelines for a work and rest cycle. The rest pauses suggested are either 'half an hour' or 'one hour period' in a work session. Light working at low temperature during early hours of the day raise physiological reactions moderately and 'half an hour' rest cause reduces cardiopulmonary activity to satisfactory levels and reduce body temperature by about 0.5°C depending upon ambient conditions. Animals involved in work of moderate to heavy intensity do not recover physiological processes even after a rest pause of 5-8 hours and fatigue effects get accumulate: such animals should be used for 2-3 days and given one day rest and work : rest days be regulated to 2:1 or 3:1 depending on level of work and need.

Work rest schedule for animals

Based on the studies conducted at Udaipur, Rewari, Pantnagar, Allahabad and Raichur, the following work-rest schedule was found better from the work Output point of view:

Bullocks

2 h work + 1 h rest + 2 h work + 1 h rest + 2h work

3 h work + 1 h rest + 3 h work

4 h work + 2 h rest + 3 h work

Buffaloes

4 h work in the morning + 3 h rest + 4 h work in the evening

2 h work + 1 h rest + 2 h work + 1 h rest + 2h work + 1 h rest + 2 h work in continuation.

Camels

2 h work + 1 h rest + 2 h work + 1 h rest + 2h work + 1 h rest + 2 h work

Donkeys

1 h work + 1 h rest + 1 h work + h rest + 1 h work up to 6 h of work

CONCLUSIONS

Most DAs do not perform work to their working capacity; therefore, the improvements need to be made in complete work system including animal, implement systems and other factors limiting performance at work. Within the capability of farmers, improvement can be achieved by proper selection, training, feeding and management. Climate is the main constrain which limit work, stresses physiological systems and induces fatigue. Therefore, adequate and timed rest pause(s) must be given to animal to recover physiological and climatic stress.

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Ghee- As Medicine

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"Ghee or clarified milk fat, is a integral property of Indian dishes for its taste and nutrition benefits. Ghee is one of the main source of fat and fat soluble vitamins like A,D,E and K. In Ayurveda medicine ghee is used as a great medicine for the treatments of many serious diseases. There are many components present in ghee that have immense therapeutic properties. So ghee is not a food but medicine."

Ghee means the pure clarified fat derived solely from milk or curd or from desi(cooking) butter or from cream to which no colouring matter or preservative has been added.The Vedas contain many references to ghee. Beginning from the vedic times (3000 to 2000 B.C.) there is recorded evidence to show that *makkhan* was extensively used by the early inhabitants of India; both in dietary and religious practices. Ghee is a fat-rich dairy products. It is a traditional product in Indian subcontinent.The importance of fat in our daily intake is gauged from the fact that vitamins A, D, E and K are made available to the body only when taken with fats. Fats also provide essential fatty acids (EFAs) especially omega-3 and omega-6, which are proven anti-inflammatory eicosanoids. In general, fats nourish the skin, cell membrane and hair. It also protects the internal organs, maintain a healthy body temperature, store energy and nourish the brain. The people of India have valued ghee for millennia, as they still do today. Ghee is the choice for classic dishes, it is essential for many aspects of temple worship, and Ayurvedic medicine praises it for health. It comes with a host of benefits many of which can be found today in Ayurvedic texts.

1. COMPOSITION:

Ghee's chemistry holds the secret to its health benefits. Ghee is made from a combination of saturated (~65%) and unsaturated (~5%) fat and monounsaturated fat (~25%). Its saturated fat is primarily made from the easy-to-digest short chain fatty acids

(89%). It also contains 3% linoleic acid which has anti-oxidant properties.

Typical ghee has the following composition: -

Characteristics	Cow milk ghee	Buffalo milk ghee
Milk fat (% by weight)	99-99.5	99-99.5
Moisture (% by weight)	0.2-0.5	0.2-0.5
Unsaponifiable matter		
(a) carotene (mg/g)	3.2-7.4	-
(b) vitamin A (IU/g)	19-34	17-38
(c) tocopherol (mg/g)	26-48	18-37
Free fatty acids (% oleic acid)	1-3	1-3

Humans need both saturated and unsaturated fats as part of a healthy diet. Ghee contains Vitamins A, D, E and K, small amounts of essential fatty acids arachidonic acid and linoleic acid. Free Fatty acid is limited to 2.8% (as % oleic acid) (Agmark standard).

2. MODE OF UTILIZATION OF GHEE:

Ghee is used in those culinary products that require fatty medium to bring taste to the product and provide satiety to the consumer at the same time. It is used at par with vegetable oils, refined oils or butter. Some of the modes of utilization of ghee are as follows:

2.1 Frying medium: Basically ghee is used for frying purpose like frying of curries, vegetables, beans, nuts and meat.

2.2 Direct consumption: Ghee is also consumed directly (with rice or *chhapatis*). Ghee is also added to different recipes, curries or soups just before serving. The main use of ghee is for frying of food and its main advantage over butter from which it is traditionally prepared is its superior keeping quality derived from the almost complete removal of water during the making process. The boiling process drives off moisture and reduces the water content effectively preventing microbial growth.

2.3. Confectionery usage: ghee is used in various confectionery items.

3. VARIOUS COMPONENTS OF GHEE AGAINST DISEASES

3.1 ANTICARCINOGENIC EFFECT OF GHEE GHEE:

Ghee or clarified milk fat contains several components that have therapeutic potential against carcinogenesis e.g. Conjugated Linoleic Acid (CLA), Sphingomyelins and short chain fatty acids like (Butyric acid) etc.

3.1.1. CLA: Conjugated linoleic acid (CLA) is a mixture of positional and geometrical isomers of linoleic acid (C18:2, cis-9, cis-12), an essential fatty acid for human and animals. CLA, besides being a powerful anti-carcinogen, has anti-atherogenic, immunomodulating and lean body mass enhancing properties.The concentration

of CLA in cow's milk is variable (from 2.4-21.8 mg of CLA/g of fat).

3.1.2 Sphingomyelin: Sphingomyelins play an important role in the development and/or prevention of chronic disease. It is the predominant membrane sphingolipid and can be hydrolyzed to form ceramides and sphingosines, which are involved in numerous cellular processes such as apoptosis, cell cycle progression, and cell differentiation.

3.1.3 Butyric Acid:

Butyric acid is a lower chain fatty acid present in milk of ruminants. In bovine milk, about one third of milk triglycerides contain one molecule of butyric acid, its amount in cow and buffalo ghee varies between 10-12 per cent. It acts as anticarcinogen by regulating cell growth and inducing cell differentiation in a wide variety of neoplastic cell lines.

3.1.4 Other Anticarcinogenic components of Ghee: Other lipids like ether lipids, vitamins and some carotenoids have been also studied for their anticarcinogenicity. Parody (1999) has reviewed the mechanism demonstrating their anticarcinogenicity. However, these components are present in very small quantity in ghee, and their anti-carcinogenic effect is yet to be established.

3.2 HYPOCHOLESTEROLEMIC EFFECTS OF GHEE

CVD are one of the major cause of death in human beings. With changing lifestyle it's occurrence in developing countries like India is increasing at an alarming rate, nearly 2.5 million Indians become victims of heart disease every year, and Indian women are the fastest rising group of coronary patients in the world. Arteriosclerosis is a process in which cholesterol containing fatty deposits accumulate on the inner walls of arteries and form bumps called plaque restricting the blood flow leading to variety of problems, from heart attack to stroke.

Serum cholesterol levels are considered as an important measure to determine vulnerability to CVDs. For Americans total blood cholesterol level of <200 mg/dl is being considered as safer level, where as for Indians the recommended level is <170 mg/dl. as the higher blood cholesterol levels are further more harmful to Indians due to higher blood serum level of lipoprotein-A. A person of Indian origin has comparatively high level of lipoprotein A in blood than a person of European or American origin. Lipoprotein-A speeds up the process of atherosclerosis, it also induces blood clot formation in the arteries. If the blood plasma level of lipoprotein goes beyond

30mg/dl then the possibility of heart attack at younger age increases by several folds. There is a wide spread belief that dietary saturated fats have a greater influence on plasma total and LDL cholesterol than dietary cholesterol. The high levels of saturated fats make the consumption of ghee more suspicious. In fact, consumption of ghee in the diet is suspected to be one of the reason for high incidences of CVD among immigrant population of South East Asians settled in Western and African countries but on the contrary, ghee was found to have hypo-cholesterolemic effect upon consumption and even used in Ayurvedic treatments of heart diseases. It is observed that there is a lower prevalence of CHD in Indian men with a higher ghee intake. In several study it was found that there was significantly lower prevalence of CHD with consumption of ghee >1kg/month.

3.2.1 Possible Mechanism of Ghee against blood Cholesterol level

Although it is not yet clear how ghee reduces blood cholesterol levels, but one of the suggested mechanism for hypo-cholesterolemic effect of ghee is mediated by increasing the secretion of biliary lipids. Other possible mechanism is the antiatherogenic effect of CLA. Ghee is one of the richest natural sources of CLA and as low as 0.05 per cent level is found to reduce total cholesterol, LDDL and TGs to 26, 27, 28 per cent respectively

4. GHEE AS A MEDICINE

Ghee has been recognized as Indian medicine in Ayurveda. It is used in various disorders both externally and internally. Being nothing but clarified milk fat, ghee is used as a medium in preparing various traditional medicines. The distribution of drug in blood is chiefly influenced by its lipid solubility, ionization, differences in the regional blood flow etc. A water-soluble drug is usually distributed in the extra cellular spaces and it may not readily diffuse in to CSF (Cerebro Spinal Fluid) and other body cavities, while the lipid soluble drugs are rapidly distributed throughout the intra and extra cellular spaces. The drugs that are rapidly absorbed from the gut because of their lipid solubility are known to readily diffuse into the CSF and the brain. This implies that drug given in the form of lipid such as ghee is rapidly absorbed and distributed in the target areas of the body like CNS. Being lipophilic, the membrane separating the CNS tissue and the circulating blood selectively allows the passage of lipids and lipid soluble drugs across it. This explains why lipid soluble drugs will not only be digested and absorbed fast, but will also be able to reach areas of body like Central Nervous

System (CNS) and showing efficacy of various psychotropic drugs given in the form of ghee. Several '*Ghritam*' or ayurvedic medicated ghee are used for external and internal use. External use of medicated ayurvedic ghee includes dressing, ointment and enema. Internal use includes usage in ayurvedic *panchakarma* therapeutic procedures. In Ayurvedic system of medicine, ghee is considered to induce several beneficial effects to human health and is used extensively for therapeutic purposes, for treating skin allergy and respiratory diseases, and is considered capable of increasing mental powers and physical appearance, and curative of ulcers and eye-diseases. Dairy ghee attenuates dietary hypercholesterolemia and decreases atherogenic index by way of increasing high-density lipoproteins.

CONCLUSION

Ghee is not only food but integral part of Indian socio economical culture. 132 million ton milk is produced in India out that a large quantities of milk produced in India is converted into Ghee. In India the market penetration of ghee is about 37% in urban areas and about 21% in rural areas. Herbal ghee or low cholesterol ghee already proved their efficacy for treatments of many type of diseases. Many components of ghee has potential effect on many serious of diseases like cancer or ulcer. Dairy scientist are working for many years for making functional ghee. We need more clinical researches to exploit the medicinal properties of ghee.

Goat Milk – A Naturally "Designed Milk" For Mankind

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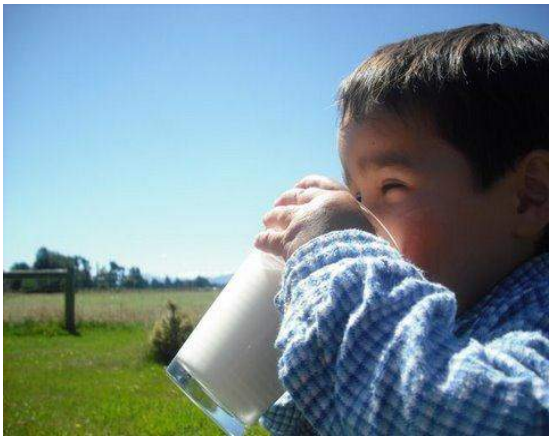
Goat is the first livestock to be domesticated and exploited by humans for milk production. Unique physiological, anatomical and biochemical differences between goat and cow species are translated into differences in the composition of goat's milk. Goat milk exceeds cow milk in its content of monounsaturated and polyunsaturated fatty acids and medium chain triglycerides, all of which are known to be beneficial for human health, in particular, prevention of cardiovascular and many other clinical conditions. Infants allergic to cow milk could able to drink goat milk with virtually no side effects in their studies. Cow milk is harder to digest. It takes your body about 2 hours to digest cow milk where as goat milk takes only 30 minutes. Goat milk contains 10% less lactose than cow milk and hence easy to digest for those suffering from lactose intolerance. Thus, Goat milk can serve as high-quality raw material for manufacturing food for infants and the elderly, as well as for certain sectors of the population with particular needs.

Goat is the first livestock to be domesticated and exploited by humans for milk production. From Bible to till date, the value of goat milk was cherished for the sustenance of the domestic household purpose which is irreplaceable, especially in dry-land areas. Unique physiological, anatomical and biochemical differences between goat and cow species are translated into differences in the composition of goat's milk. Goat milk is popular in in USA, Mediterranean Basin and U.K as the suppliers of milk and milk products. However, in India, big budget



marketing or high profile campaigning of dairy Industry made to hide the significant contribution and merits of Goat milk for human consumption over Cow milk. Goat milk also has several attributes that make it far superior choice to cow milk.

THERAPEUTIC SIGNIFICANCE OF GOAT MILK

Medicinal benefits included improved digestion in irritable bowl syndrome, reducing the symptoms of asthma and eczema. Oligosaccharides in goat milk can act as a prebiotic which help to maintain the health of the gastrointestinal tract by encouraging the growth of beneficial gut bacteria

and preventing the growth of detrimental bacteria. Further, they reduce intestinal inflammation and aid in recovery from colitis in animals. Goat milk has significantly greater

amounts of vitamin B_6, vitamin A, and niacin than Cow milk. Whereas, fat and protein are 0.04% and 0.27% less than Cow milk, respectively. Adult daily dietary essential amino acids requirement would be met equally or exceeded by a 0.5 litre goat milk consumption compared to cow milk (NRC, 1968).

Goat milk contains higher levels of Calcium, Phosphorus, Magnesium, Pottasium, Chlorine, Iron and Copper than that of cow/human milk. Consumption of goat milk ensures more bioavailability of iron, calcium, phosphorous and zinc than cow milk. Phosphorus contributes to the higher buffering capacity of goat milk, which makes it valuable in treating stomach ulcers. The high chloride content may have bearing on its laxative properties. Extensive amount of potassium in goat's milk makes it to react in an

alkaline way within the body whereas cow milk is lacking in potassium and ends up reacting in an acidic way.

Goat milk exceeds cow milk in its content of monounsaturated and polyunsaturated fatty acids and medium chain triglycerides, all of which are known to be beneficial for human health, in particular, prevention of cardiovascular conditions. Goat milk has a greater amount of essential fatty acids such as linoleic and arachidonic acid than cow milk. Consumption of goat milk reduces total cholesterol levels and the LDL fraction because of the higher presence of medium chain triglycerides (36% in goat milk versus 21% in cow milk), which decreases the synthesis of endogenous cholesterol.

Capric, caprylic, caproic acids are predominantly present in goat milk. Consequently, they are named after goat (Haenlein, G.F.W. 2004). These fatty acids have been used in medical treatment for an array of clinical disorders, including malabsorption syndromes, chyluria, steatorrhea, hyperlipoproteinemia, intestinal resection, premature infant feeding, non-thriftiness of children, infant malnutrition, epilepsy, cystic fibrosis, coronary by-pass, and gallstones, because of their unique metabolic ability to provide direct energy instead of being deposited in adipose tissues.

HYPOALLERGENIC MILK

Most common allergic reactions for 0-3 year's children is cow milk allergy, due to its 20 different proteins. A food allergy is an exaggerated immune response triggered by a specific food which mistake by body recognizes as a harmful substance. The major proteins that people are allergic are lactoglobulins , alpha s1 caesins in cow milk. Mild side effects include vomiting, diarrhea, skin rashes and severe effects can be as serious as anaphylactic shock. Goat milk contains a similar amount of lactoglobulins as cow milk which is not present in human milk but less of alphas1-casein. Goat's milk, like human milk, has a lower ratio of casein because the amounts of soluble proteins are higher than those found in cow and sheep milk. This unique property allows the milk to form a soft curd during digestion by rennin in stomach of infants. The levels of Alpha s1 Casein in goat milk are about 89% less than cow milk providing a far less

allergenic food. Genetic polymorphisms of the different caseins and whey proteins adds to the complexity of the cow milk allergy situation and it is very difficult to determine which protein is mainly responsible for an allergic reaction. Those who are experiencing intolerance to casein may therefore find, they have reduced symptoms when consuming goat milk. Reinertand Fabre (1997) had shown that 93% Infants allergic to cow milk could able to drink goat milk with virtually no side effects in their studies.

NATURALLY HOMOGENIZED GOAT MILK

In cow milk separation of cream and whey occurs naturally, due to the presence of large sized fat globules and agglutinins. Dairy industry utilizes a process called homogenization for commercial milk distribution. This method works by forcing the fluid milk through a tiny hole under tremendous pressure which destroys the fat globules, cell wall and allows the milk and cream to stay homogeneous or suspended and well mixed.

The problem with such homogenization is that once the cell wall of the fat globule has been broken, it releases a superoxide (free radical) known as Xanthine Oxidase. Free radicals cause cellular damage and other problems in the body, the least of which is DNA mutations which often lead to cancer. Since, Goat's milk has smaller fat globules and does not contain agglutinin which allows it to

stay naturally homogenized. This property of Goat milk can be thought for eliminating the dangers associated with homogenization process.

EASILY DIGESTIBLE GOAT MILK

Cow milk is harder to digest. It takes your body about 2 hours to digest cow milk where as goat milk takes only 30 minutes. Goat milk with the genetic trait of low or no α-s-1-casein, but instead with α-s-2-casein, has less curd

yield, longer rennet coagulation time, more heat liability, and weaker curd firmness, which may also explain the benefits in digestibility in the human digestive tract. Goat milk has smaller fat globules with high levels of medium chain fatty acids providing, each fat globule and individual fatty acid with larger surface-to-volume ratio during digestion process. Hence, facilitating quicker and easier digestion process. The proteins found in goat milk denature in the stomach, they form a much softer bolus or curd than cow milk. This allows the body to digest the protein more smoothly and completely than cow milk.

LACTOSE INTOLERANCE RESISTANT PROPERTY OF GOAT MILK

Milk sugar called lactose is an important carbohydrate part in the milk. Recent studies showed that relatively a large portion of the population suffers from a deficiency of an enzyme known as lactase, which break the lactose into glucose and galactose. This deficiency results in a condition known as lactose intolerance which is a fairly common ailment due to carbohydrate sensitivity. Goat milk contains 10% less lactose than cow milk and hence easy to digest for those suffering from lactose intolerance.

THERMODYNAMIC SIMILARITY BETWEEN MAN AND GOAT

A baby starts life at around 2.5 – 4.3 kg, a baby goat (kid) usually starts life at around as same weight as infant, where as a calf usually starts life at around 35-45 Kg. As rightly pointed out by Dr. Thomas Crooke speaking on purely thermodynamic position, these two animals have very significant and different nutritional needs for both maintenance and growth requirements. Cow milk is designed to take a 45 kg calf and transform it into a approximately 450-500 kg cow. Goat milk and human milk were both designed and created for transforming a 2.5-4.3 Kg baby/kid into an average adult/goat of anywhere between 45-85 Kg. Increase in obesity rates in humans might me due to this significant thermodynamic discrepancy. Thus, thermodynamically speaking- Goat milk matches with human body growth rate and better for human consumption than Cow milk. Goat milk, a naturally homogenized milk, is also a less food allergen and lactose intolerant friendly

to overcome the food hypersentivity reactions, easier to digest and thermodynamically also Goat's milk is closest in structure to human milk. Biomedical superiority of goat Milk has not been promoted much in marketing, but has a greater potential in justifying the uniqueness of goat milk in human nutrition, health and medicine in future. elderly, as well as for certain sectors of the population with particular needs. Thus, Goat milk can serve as high-quality raw material for manufacturing food for infants and the

Comparison of Cow and Goat milk Composition

Nutrients	Cow milk	Goat Milk
Energy (k/cal)	61	69
lactose (g)	4.6	4.4
Water (%)	87.5	86.8
Protein (%)	3.2	3.3
fat (%)	4.1	4.5
Cholesterol (mg)	14	11
Ash (%)	0.8	0.8
calcium (mg)	120	170
Phosphorus (mg)	90	120
Sodium (mg)	16	11
Potassium (mg)	140	110
Iron (mg)	0.2	0.3
selenium mcg	9	3.4
magnesium mg	24	34.2
Vitamin A IU	2491	4831
Vitamin D IU	981	30
Vitamin E mg	0.15	0.2
Vitamin K mcg	0.5	0.7
Vitamin B6 mcg	0.100	0.112

Vitamin B12 mcg	1.1	0.2
folate mcg	12	2.4

Consume the right food for better health…….

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The Output and Nature of Cattle Waste

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Cow dung is one of the most abundant wastes generated on earth and has been traditionally used as fertilizer and fuel in most of the developing countries. Manure management is a key factor of successful lot feeding. With the increasing environmental awareness of the public, and tighter economic margins, manure management can no longer be considered to be a chore, but as an integral component of the overall feedlot operation. Manure has high nutrient value and is very suitable for use as an organic fertilizer. The costs and returns of manure management need to be optimized. Concerns about the effects of livestock operations on the environment generally relate to nutrients and other compounds excreted in manure. Greater cow numbers and use of fertilizer N along with higher supplementary feed inputs on dairy farms has resulted in marked changes in the volume, content and types of effluent produced.

Determining Manure Production and Composition

Manure quantities and characteristics can be estimated on an:

1. As excreted basis or as

2. Recoverable manure nutrients (the quantity of manure nutrients available for land application or utilization for other purposes).

AS EXCRETED BASIS

There are tabulated values that can be used to estimate the amount of manure an animal produces. These average estimates of manure excreted become obsolete due to changes in animal genetics, feeding program strategies, and available feeds. Although sampling and the use of tabulated estimates are the most common methods of estimating manure nutrients there is equations for predicting nutrient excretion (primarily nitrogen and phosphorus), dry matter, and (depending upon species) other potential characteristics have been assembled for beef, dairy, swine, horses,

and poultry. Software can simplify the use of these equations.

It is appropriate to use the equations to calculate manure excretions:

Total Weight = manure weight + bedding weight

Total Volume = manure volume + (bedding volume/2)

OUTPUT OF MANURE

- Manure is feces plus urine; manure is approximately 88% water and its density is approximately 960 kg/cubic meter.
- Output of a typical 450 kg feedlot beast. Feed consumption is typically 2.5 to 3.0% of body weight depending on the type of diet. For a 450 kg animal, this is about 12 kg of feed intake per day. As weight gain is 1 to 1.6 kg per day, the remainder must leave the animal - partly as manure (the combination of feces and urine) and partly via belching (as gas). Cattle also drink considerable quantities of water with the daily volume depending on body weight, diet and climatic conditions.
- Some of this water is lost to the atmosphere via respiration; however, a considerable proportion is voided as part of the manure.
- Typically, manure is 85% to 90% water. The daily manure production of a 450 kg beast is about 27 kg per day, which is about 5 to 6% of body weight. Of the 27 kg, about 24 kg is water and 3 kg is solid material (dry matter).
- Cattle retain less than 20% of the nutrients they consume; hence, the remainder is ultimately excreted in feces and urine or lost as gaseous carbon dioxide or methane.
- On an average week. 1000 feeder calves weighing 340 kg will excrete approximately 15,000 kg of dry matter, 900 kg of nitrogen, 122 kg of phosphorus, and 272kg of potassium.

Factors influencing the composition of the manure are

1. The kind of animal producing it

There is considerable variation in the manure of different animals, due in part to the amount of water carried in the excrements. Cow and buffalo manures carry much more water than the manure from sheep and goat, and are therefore less concentrated, or, in other words, carry a smaller percentage of nitrogen, phosphorus, and potassium.

2. The food the animals consume

The composition of farm manure is also greatly influenced by the character of the

food consumed. The nitrogen, phosphorus, and potassium taken into the body pass through largely in the form of excrements. It is therefore obvious that the amount of these elements in the excrements is more or less dependent on the food eaten.

3. The kind and quantity of litter used in the animal house

The composition of the manure is influenced by the litter, the value of ,which from a fertilizing standpoint is (a) to absorb and retain urine, (b) to increase organic matter and plant food, (c) to prevent the escape of ammonia in the air, (d) to make the material easier to handle, and (e) to influence physical and chemical action. The materials most commonly used as litter are straw from the various cereal crops (such as oats, rye, barley, and wheat), muck, peat-moss, sawdust, shavings.

Composition of Cow Dung

- The composition of cow dung manure is basically digested grass and grain. The grass and grain which they eat is not easily digested and remain up to some extent in their residue. The grass has the high cellulose content, although there are some species of microorganisms found in the guts of these animals. They actively work upon the grass and other substrate material to break it into their simpler compounds.
- The part which is not digested here is forwarded to stomach where in presence digestive juice its gets digested. It has the high roughage content.
- Cow dung provides high levels of organic materials and rich in nutrients. It contains about 3 percent nitrogen, 2 percent phosphorous, and 1 percent potassium (3-2-1 NPK).
- It contains high levels of ammonia which is potentially dangerous for pathogens. The growth of the pathogens is almost ceased due to its use.
- Many trace elements, vitamin K_2, most of the vitamins of the B group and other vitamins or pro-vitamins are found in fresh animal wastes in larger quantities than in the original feed. (Muller *et al.*, 1968)
- The fraction of lignin in cow feces is dependent on the feed. Historically, the predominant fodder was pasture and hay, which recently has been estimated to have a lignin content of approximately 2 to 8%. Legume fodder often has a higher lignin content of up

to approximately 12%. The lignin is almost wholly indigestible and so is passed directly into the feces. Van Soest (1982), pp.43-44.

- Ivermectin excreted in cattle dung after subcutaneous injection or pour-on treatment.

COW MANURE

A ton of average fresh manure contains 1,720 pounds of water, 12 pounds of nitrogen, 3 pounds of phosphoric acid, and 9 pounds of potash. It represents material that is more completely digested than does horse manure, and is far more compact. Due to the compactness and also to the larger amount of water in cow manure, there is not the same danger of losses through heating.

SHEEP MANURE

A ton of average fresh sheep manure contains 1,360 pounds of water, 19 pounds of nitrogen, 7 pounds of .phosphoric acid and 20 pounds of potash. It is a quick-acting fertilizer.

Physical property

Total solids (TS)

The choice of effluent management system is constrained by the total solids content of the material to be handled. The TS content of manure 'as-excreted' may range from 8% to 15% and can therefore be described as a liquid or semi-liquid (a slurry). Material of this concentration is usually conveyed by augers or manure tankers. After yard and plant wash is added, the TS content of the diluted effluent is usually between 0.5% and 1.2%. The average values are as follows

Total solids (TS) 15% (w/w)

Volatile solids 85% of TS

Total carbon 45% of TS

Total nitrogen 2.5% of TS

Volatile solids (VS)

The volatile solids component is the organic matter or degradable component that must be removed or stabilized during treatment. The VS component of dairy cattle feces is generally 80% to 86% of TS, the remainder being ash (FS) (Zhang *et al.* 2003, Wright 2005, ASAE 2005). Any extraneous material such as laneway material walked in on hooves, soil washed from earthen pads or sand bedding entering the effluent stream will reduce the ratio of VS to FS.

Fixed solids (FS)

The fixed solids constitute the residual inorganic compounds (N, P, K, Ca, Cu, Zn, Fe etc.) in a suspended or dissolved state. In dilute effluents, these minerals are mainly dissolved, and their removal from the effluent stream is difficult.

Suspended solids (SS)

The content of total SS ranges from 62% to 83% of TS and sets the theoretical limit of performance for separation systems. The majority of SS is volatile (VSS): approximately 80% and the rest is fixed (FSS).

Total dissolved solids (TDS)

All dissolved solids (TDS) are ions. There is a strong correlation between TDS and the electrical conductivity (EC) of effluent.

Chemical & Biological Composition Indicator

The pH of manure is 6.6

BIOLOGICAL OXYGEN DEMAND (BOD)

Biological oxygen demand is an index of the oxygen-demanding properties of biodegradable material in water. It is a useful measure for assessing the strength of effluent and its pollution potential. The reproductive rate of the bacteria responsible for nitrification oxygen demand is slow, it normally takes 6 to 10 days for them to influence the BOD measure. Unless specified otherwise, BOD values usually refer to the standard 5-day value (BOD5), measured within the carbon demand stage. Note that the BOD5 of animal effluents cannot be compared to that of sewage, as BOD5 of sewage represents 68% to80% of the ultimate BOD, whereas that of animal effluents is only 16% to 26%. Typically, dairy effluent (unless substantially diluted) has a BOD5 of the order of 2500–4000 mg·L–1. Although much of the organic matter in dairy effluent is derived from manure, the contribution from spilt milk or flushing milk lines cannot be ignored. Raw milk has a BOD5 of 100 000 mg·L–1 and has the potential to be a powerful pollutant if inappropriately managed.

CHEMICAL OXYGEN DEMAND (COD)

Chemical oxygen demand is the amount of oxygen consumed during the oxidation of organic carbon under a high-temperature, strongly acidic chemical digestion process. COD is frequently used in monitoring treatment processes, as it can be completed in 1 to 3 h (rather than the 5 days for BOD5). However, since it is a chemical process, the biodegradability prospects for the material are not given. The COD:BOD5 ratio is frequently used as an indicator of biological degradability: ratios exceeding 5:1 indicate low digestibility. The COD:BOD5 ratio of dairy effluent is typically 7:1 to 12:1.

Table 1: Depending upon the animal size composition varies as follows:

Animal size (kg)	Manure production (kg/day)	Total solids (kg/day)	Volatile solids (kg/day)	BOD* (kg/day)	Nutrient content (kg/day)		
					N	P	K
220	13.2	1.54	1.32	0.35	0.075	0.024	0.052
300	18.0	2.08	1.06	0.48	0.104	0.034	0.076
450	27.0	3.10	2.70	0.72	0.153	0.050	0.108
600	36.0	4.18	3.56	0.96	0.206	0.068	0.149

Table 2:Composition of dried manure

Component	% of Dry Matter
Ash	13.3-13.4%
Nitrogen	1.2-1.6%
NDF	77.7-83.5%
ADF	50.5-52.7%
Cellulose (ADF-ADL)	35.4%
Hemicellulose (NDF-ADF)	32.0%

Table 3: Distribution Of Nitrogen In Faeces And Urine

Species	% of Total N	
	Feces	Urine
Beef cattle	50	50
Dairy cattle	60	40
Sheep	50	50

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Maternal Behavior in Cattle

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Domestication of cattle occurred approximately 6000–8000 years ago. When domesticated cattle are permitted to rear their young most of the behaviors related with maternal care are found to be similar to those observed in wild ungulates. These components of maternal behavior play an important role in the success of dairy production systems. For example, dairy cattle production system takes advantage of the cows' ability to provide nourishment for her young. In extensive forms of dairy production, including organic dairying, can involve longer periods of cow–calf contact and benefit from a strong maternal bond and the expression of maternal behaviors including licking, nursing and protection from potential predators which was not seen in the intensive dairy production systems.

MATERNAL BEHAVIOR

Maternal behavior can be divided in two parts; a care giving (Epimeletic) behavior and a care seeking behavior phase. The care giving behavior appears soon after parturition. After giving birth to the calf, cow's sense of smell helps her to recognize her calf. Then the cow starts to lick, grooming and nursing her calf these includes are the part of care giving behavior. The care giving behaviors of cows start to decline after approximately 120 days of calf life.

FUNDAMENTALS OF MATERNAL BEHAVIOR

The periparturient dam showed three distinct changes in behavior (Houwing et al., 1990)

1) Preparturient changes leading to parturition
2) Calf related activities and

3) Return of maintenance behavior after weaning

PRE-PARTUM BEHAVIOR

Cows are naturally sociable animal even though they isolate themselves from herd mates and choose a nesting site before calving this initiates the maternal behavior. In general isolation is to maintain higher inter-individual distances, especially from older cows. But when cows are kept at higher stocking densities (3 cows/ha) or group housed indoors this tendency to separate from herd mates is less evident. Cattle appear to spend little effort in preparing a nesting site probable because the new born young spend little time at the birth site after parturition. Approximately only one third of cows performed 'nestbuilding-like behavior' in the couple of hours before calving. Cows favors dry calving sites, especially with tree cover and branches overhead. Cows also use shelter for calving when this was available. Most cows choose to calve indoors rather than in a 1-ha paddock. Restlessness and postural changes are the most common behavior which cows shows immediately before calving possibly due to discomfort. Before calving, the number of standing bouts (i.e. any period standing between two lying events) increases. Similar to other ungulates majority of cows give birth in the recumbent position and about 77 % and stood soon after calving. Cows may be reluctant to stand after a difficult calving (dystocia), but there is little research to document this effect. Edwards and Broom (1982) reported that first parity cows experiencing difficult births had increased latency to stand in the following calving.

INITIATION OF MATERNAL BEHAVIOR

a) Licking and grooming the calf

After giving birth, cows lick the neonate by this activity the amniotic fluid covering neonate is removed. It also stimulates smooth breathing, circulation, urination and defecation. Twins may receive less grooming than single calves. Cows will lick the urogenital/rectal areas to stimulate urination and defecation (Hafez, 2000). Grooming is done directly from the dorsal of the neonate and its head to ventral areas and limbs. This maternal activity draws neonatal first interest towards its mother. While licking dams saliva spread over the neonate which soon dried up and impart familiar pheromonal identity to the newborn. This is important for the social exchange between young and mature. Cows begin licking their calf 1–7 min after birth and intensively groom the calf for the

next 30–40 min. Cow spend maximum 30–50% time in licking during the first hour after birth and gradually it decreases (Jensen, 2011), much as has been reported for ewes while calves' sniffing the cow peaked during the second hour after birth (Jensen, 2011) and continues during the first 6-h period. Cows with previous experience (multiparous) lick their offspring for longer periods than do the inexperienced (primiparous) mothers. Interestingly, about 56% of the licking bouts are associated with suckling. Multiparous cows show higher intensities of licking during the first hour after birth, but primiparous cows increase licking during the second hour after birth (Edwards and Broom, 1982).

b) Vocalizations

Cows are vocal animals and call in response to a range of conditions. Cow makes three distinct sounds, loud bellows are made during initial licking, than later soft pharyngeal grunts are made and during nursing louder with low pitched and short bleats is heard. Quiet grunting sounds are common in the first few hours after calving and these calls are often used in combination with licking. 3- to 5-week-old calves could recognize their mothers using vocal cues, though it is not clear whether cows recognize their offspring in this way. Cows and calves respond behaviorally to each other's calls and calves respond preferentially to calls from their own dam

c) Suckling

Once the new born stands, almost all of its activities are initially concerned with teat-seeking. The dam may act in a way that helps the young to find the teats or may behavior that is not helpful to the young. The dam does not simply receive the soliciting approaches passively but shows positive orientation in accommodating them. Some of the heifers were found to butt or kick the calf as it approached. Some heifer likes to make movements that interrupt suckling. The latency to first nurse is an important issue in cattle management, because in dairy cattle it is longer with older cows because their pendulous udders make it difficult for the calf to locate a teat. Latency period is also longer in primiparous than multiparous cows because some primiparous animals have difficulties in accepting their calves. The calf's immunity primarily relies upon absorbing immunoglobulins found in the colostrums during the first 12 h after birth and it was

found that calves that receive colostrum after this time show low levels of immunoglobulins in their serum.

BOND FORMATION

There is a very short critical period after parturition during which the dam will form a bond with her offspring. During this period maternal behavior is under hormonal control but after that the newborn has to provide cues that stimulate the mother to remain maternal. In cattle it last up to 3 h after parturition. It seems that only a short period of contact (< 30 min) is needed to establish a bond which enables the mother to identify its own offspring from other one. Contact between the cow and her calf for a period as brief as 5 minutes postpartum results in a strong specific maternal bond. Smelling the anal-genital area usually makes the final identification.

CROSS FOSTERING

Some time cow rejects her own calf this represents a failure of the natural bond between cow and calf. Wetting a calf's coat with amniotic fluid will induce licking by the foster mother. Foster calves are generally not able to nurse as much as the cows own calf, resulting in poorer weight gains. But some study shows that there is no difference between acceptances of foster calves to the cows which had been separated from their own calf.

WEANING

When the cows are separated from the calf shortly after calving, cows show a clear behavioral response, including increases in vocalizations and activity, which in nature would serve to reunite the cow and calf. Interestingly, this behavioral response increases if cow and calf are kept together for several days before separation, this makes stronger maternal bonding to occur.

CONCLUSION

In modern era, the diversity in farming systems which are in use to rear cattle in large farms, and ease with which these systems can be manipulated to increase the production system of the farm, maternal behavior of cattle provides a rich scope for understanding the factors which are important for the good managemental farming systems. The normal behavior of cattle during peri-partum period reflects the good health status of the cattle and the information from maternal behavior during this period can be implemented for the better calf management during the early phase of calf hood.

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Essential Oil in Flowers: Value Addition

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Value-added floriculture is a process of increasing the economic value and consumer appeal of any floricultural commodity. Profit potential is increased when any indistinctive raw commodity is converted into a unique product. The value-addition for marketing flowers includes adoption of post-harvest technology and improved logistics. Export of value-added product e.g. oil (extracted in small units set up in production zones) rather than the raw material e.g. rose petals, can help generate substantial revenue in international market. Working with flowers is of course a benefit, but a successful operation requires a great deal of highly specialised knowledge and skills, since the industry is highly technical and scientific. Value-added products from floriculture includes essential oils from ornamental plants, extraction of dyes from plants and flowers, extraction of plant pigments, fresh flower products (bouquets, arrangements, etc.) and dried flowers and plant parts, etc. All higher plants have some kind of aroma or flavour in their various parts which include roots, stems, leaves, flowers and fruits. The flavour and aroma in a particular part is due to the presence of essential oils present in special glands in it.

The word perfume has been used today to describe scented mixtures and is derived from the latin word, "*per fumum*", meaning "through smoke". Perfumes, essential oils and aroma are some of the products which indicate religious values, living standards, personality development for personal use and adornment from years back. Essential oil is a concentrated hydrophobic liquid containing volatile aroma compounds from

plants. Essential oils are also known as volatile oils, ethereal oils or aetherolea, or simply as the "oil of the plant" from which they were extracted. Oil is "essential" in the sense that it carries a distinctive scent, or essence, of the plant and is therefore used in food flavouring, perfumery and therapeutically in aromatherapy.

SCENARIO OF ESSENTIAL OILS

Global Estimated world production of perfume oils, for all applications taken together is about 250,000 tons. The global export of these oils, perfumes and flavours increased from US $ 2149 million in 1986 to US $ 8254 million during 2002 while imports recorded an increase from US $ 2008 to US $ 5316 during the same period. On the production side, the total worldwide production of essential oils is estimated at about 1,00,000 to 1,10,1000 tonnes. The production of geranium essential oil alone is estimated to be nearly 400 tonnes per annum, with a value of US $ 20-30 million. The world's largest importer of aromatic materials is the USA followed by Japan (Verma *et al.*, 2012).

Indian India ranks 26th in import &14th in respect of export in world in the trade of essential oil. India holds around 0.7% of import & 1.1% of export. Jasmine and tuberose concentrate from South India have created a marks in world marked. The major buyers of Indian essential oil are Former USSR, USA, France, UK, Netherlands, UAE and Saudi Arabia. Growth in perfumery is higher i.e., 15% in India compared to 7% in America and 5% in Europe (Verma *et al.*, 2012).

OPPORTUNITIES IN THE ESSENTIAL OIL INDUSTRY

Essential oils are widely used in manufacturing of perfumes, creams, after shave lotions, soaps, detergents, incense, shampoos, bath oils, hair oils, talcum powder and other cosmetics. They are also used for flavouring all types of food products like candies, beverages, tobacco, soups, chewing gum, sauces, desserts, cake mixes, etc. Besides, they are used as therapeutics, antiseptics, bactericides or germicides and are also used in making balms, tooth pastes, mouth washes, antiperspirants, deodorants, insecticides and aerosols. Other uses include protecting of fur, wool, silk clothing and for making shoe polish and also as solvents in the paint and varnish industry and even in plastic and textile industry.

Essential oils hold important place in reference to Aromatherapy. It is a form of alternative medicine that uses volatile plant

materials, known as essential oils and other aromatic compounds for the purpose of altering a person's mind, mood, cognitive function or health.

The modes of application of aromatherapy include i) *Aerial diffusion*: for environmental fragrance or aerial disinfection, ii) *Direct inhalation*: for respiratory disinfection, decongestion, expectoration as well as psychological effects and iii) *Topical applications*: for general massage, baths, compresses, therapeutic skin care

DIFFERENT OIL EXTRACTION METHODS FOR FLOWERS

There are five methods of extracting essential oil from flowers viz., i) ***Distillation-*** There are three types of distillation used: Water or Hydro distillation; Water and steam or wet steam distillation; and Direct steam or dry steam distillation, ii) ***Enfleurage-*** This process is useful to extract delicate floral scents from flowers that produce essential oils even after being picked (for example; jasmine, tuberose, violets, etc.) or where the oil is affected by higher temperatures, iii) ***Maceration-*** In this method, successive batches of chopped plant materials are digested with hot oil at 45-80^{o}C for several hours. The filtrate is heated with successive batches of fresh flowers up to 20 times, iv) ***Solvent extraction-*** Whenever oil with natural flavour is required, direct extraction with solvents such as petroleum ether or benzene is practised, v) ***Mechanical expression-*** In this process, the fruits are compressed or squeezed in claw-shaped bowls where juice is sucked out of the fruit through a cannula inserted in the pulp, while the oil released from the oil cells is rinsed with water and then the two are separated by centrifugation or the fruits are placed in a revolving vessel fitted with spikes to release the oils, vi) ***Adsorption-*** In this process, hot air or inert gas is passed over the aromatic plant material which is then led through the activated carbon from which the essential oils are recovered by solvents.

There are some recent techniques also being used for essential oil extraction. These include i) *Spercritical Fluid Extraction* -Carbon dioxide is the most popular solvent used in SFE. This technique is used for extraction of essential oils in sandal wood, conifers, tanacetum, etc. ii) *Solidphase Micro Extraction* -This method is used for the determination of humulene and caryophyllene in the head space of female hop cones and male hop lupulin samples. For the determination of the

humulene to caryophyllene (H:C) ratio for female hops and male lupulin samples including a 100-aemploy (dimethyl siloxone), iii) *Simultaneous Distillation Extraction* --This method is used for extraction of essential oils in conifers, paprika, etc. In this method, both atmospheric and reduced pressure can be employed, Storage of essential oils is very important. The essential oils are stored in cool dry cellars, in hermetically sealed amber glass containers to prevent browning due to polymerisation.

FLOWERS YIELDING ESSENTIAL OILS

***Rosa sp.*:** About 10 tonnes of rose oil is produced in the world out of which Bulgaria produces more than 5 tonnes. India produces a very small amount of rose oil, which does not exceed 10 kg. Important constituents of rose oil are : 1-citronellol (40-65%), nerol, gereniol, linalool, eugenol etc. Recovery and Yield: In Bulgaria, *Rosa damascene* yielded 1 kg oil/4000 kg of flowers, when extracted in industrial still. *Rosa damascene* yields 0.05% oil, of highest quality which fetches highest price.

Rosa damascene
(Damask rose)

Rosa centifolia

Rosa bourboniana

***Jasminum sp.*:** Next to rose, jasmine is the most important perfumery raw material used since the beginning of human civilization. The word 'jasmine' is derived from Persian word '*yasmyn*' meaning 'fragrance'.Jasmines are cultivated throughout our country in an area of 8000 ha. Egypt is the largest producer (10-15 tonnes concrete/yr) followed by Morocco, France, Algeria, Italy and India. Main constituents of jasmine concrete are benzyl acetate, benzyl benzoate, geraniol,

eugenol, benzaldehyde, indole, nerol, methyl jasmonate etc. *Jasminumauriculatum*or 'Juhi'has highest oil recovery (0.29%).Important varieties are Parimullai, CO-1 Mullai, CO-2 Mullai

*Jasminumgrandiflorum*or 'Chameli' has best Quality oil (0.25-0.30%). Important varieties are JG 1, JG 2, JG 3, JG 4, JG 5, JG 6, CO1 Pitchi and CO2 Pitchi

Jasminumauriculatum

Jasminumgrandiflorum

Jasminumsambac

Tagetes sp In India, four species *T.erecta; T. patula; T. signata; T. minuta* have been naturalized for processing of essential oil. The plant and essential oils have been found to be repellent to the common house fly, *Muscan ebulo.* The ethanolic extract of the entire herb showed antiviral activity against *Ranikhet*-disease virus. Volatile oil isolated from *Tagetes minuta* exhibites Tranquillizing, Hypotensive, Spasmolytic, bronchodilatory and anti inflammatory properties.

Tageteserecta(African Marigold)

Tagetespatula (French Marigold)

Tagetesminuta

Polianthes tuberosa About 30,000 kg loose flowers give 27.5 kg of concrete and this concrete gives 5.50 kg absolute. Generally, 1 kg concrete is obtained from 1150 kg of flowers. Oil is used on heavier types of scents and also used in non alcoholic beverages, ice cream, candy, baked goods.

Lavandula angustifolia The fragrant oils of its flowers are used in aromatherapy, baked goods, candles, cosmetics, detergents, jellies, massage oils, perfumes, powders, shampoo, soaps, and tea. Yield is 0.81% on steam distillation. Known chemical constituents of Volatile oil include linalyl acetate, linalool, borneol.

Pandanus fascicularia It is distributed in tropical areas and in India, it is found growing in the coastal district of Orissa, Gujarat, Andhra Pradesh and Tamil Nadu. Male inflorescence exhales odour and it is an economically important part of the plant which is highly scented. Attar is used for flavouring hair oils, soaps, bouquets, cosmetics, snuff and incense.

Lavandula angustifolia

Polianthes tuberosa

Pandanus fascicularia (Kewra)

Achoruscalamus Its essential oil is extracted from the roots by steam distillation and has been used since ancient times as one of the ingredients of the holy anointing oil. Traditionally, this herb was smoked, eaten, or brewed into a tea, decoction, extract and syrup. The oil has the compound *asarone* which has tranquilizing and antibiotic activity but is also potentially toxic and can cause mild hallucinations. So it should be well diluted before use.

Other important essential oil-bearing ornamentals

Michelia champaca, Narcissus, Magnolia sp., Sweet pea, *Cestrum nocturnum, Gardenia jasminoides, Iris sp., Dianthus caryophyllus, Michelia champaca,* etc.

Michelia champaka

Iris spp.

Rhizomes of Iris

Pelargonium graveolens (Geranium)

Gardenia jasminoides

Cestrum nocturnum (Night Queen)

ESSENTIAL OILS FOR PLANT PROTECTION

Hashem *et al*., (2010) succeeded to control root rot of cumin caused by different *Fusarium spp.* under greenhouse and field conditions through the application of cumin, basil and geranium essential oils. Kadoglidou *et al*., (2011) examined the effect of lavender, oregano, sage and spearmint essential oils on growth of *Aspergillus*, *Fusarium*, *Penicillium* and *Verticillium* fungi. All tested essential oils and their individual monoterpinoids inhibited mycelia growth in all fungi. Kabera *et al*., (2011) evaluated the effect of essential oils of *Pelargonium graveolens* and *Cymbopogon citrates* on maize weevil (*Sitophilus zeamais*) and found 90% mortality of weevils that come in contact or ingest

contaminated food and only 40% when inhaled.

ESSENTIAL OILS AS THERAPEUTICS

Essential oils are have antimicrobial activity. Shunying *et al*., (2005) evaluated the antimicrobial activity of essential oils from air-dried and processed flowers of *Chrysanthemum indicum* and found out that the oil of the processed flowers with higher percentage of camphor, exhibited greater bacteriostatic activity. Adamczak *et al*., (2011) determined the variability in the content of oil and main fatty acids in hips of all native rose species of section *Caninae*. Katsukawa *et al*., (2011) identified geraniol and citronellol, the major chemical components of rose oil, as suppressors of COX-2 expression and activators of PPAR α and γ; this may be important in understanding the anti-inflammatory and anti-lifestyle-related disease properties of these chemicals.Lodhia et al., (2009) tested the anti-bacterial activities of essential oils extracted from flower petals of palmarosa, evening primrose, lavender and tuberose against gram-positive and gram-negative bacteria. Palmarosa oil showed the highest activity against both bacteria among the tested essential oils.

YIELD AND CHEMICAL COMPOSITION

Ahmad *et al*. (1998) found that the quality of jasmine concrete obtained from morning harvested flowers was better than evening harvested flowers. Harvest time did not affect the quantity of jasmine concrete. Zhu Shunying *et al*., (2005) analyzed three essential oils of fresh, air-dried and processed flowers of

Chrysanthemum indicum and found out that major constituents of oils were 1,8-cineole, camphor, borneol and bornyl acetate, but the percentage of these compound varied greatly because of the processing of flowers. Okoh *et al*., (2008) extracted the essential oils of fresh leaves, dry leaves and fresh flowers of *Calendula officinalis* by hydrodistillation yielding 0.06, 0.03 and 0.09%, respectively. The analysis of the oils by GC-MS revealed a

total of 30, 21 and 24 compounds from fresh leaves, dry leaves and the flowers in the same order.

FUTURE PROSPECTS OF ESSENTIAL OIL INDUSTRY

A number of compounds in these oils (and the oils themselves) have medicinal, pharmacological, bactericidal, fungicidal, pesticidal, therapeutical properties and are used in the cosmetic, flavor and fragrance or perfumery industries. The use of essential oils in any form stated above is highly desirable, since they are economical as well as eco-friendly. Flower and fragrance plant industry is an upcoming sector with tremendous opportunities for India to have its due share in the international trade in essential oils. Worldwide demand for flavours and fragrances including blends, essential oils and other natural extracts is projected to increase 4.3 percent per year. The best opportunities for flavours and fragrances will be found in the Asia/Pacific region, which accounts for one-third of total value gains between 2009 and 2014. US is the world's largest user of flavours and fragrances, the fastest growth will occur in developing regions like Asia, Central and South America, Eastern Europe and the Africa/Mideast region. The industry use flavours in processed food, snacks, soft drinks, candy and confectionaries and other items like seafood products, sauces, condiments etc as per the requirement of the consumers.

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Scenario of Production, Demand, Supply, Seasonal Distribution, Quality and Selection Criteria of Green Fodders in India

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"With the growing need of the ever increasing population of India, it is necessary to provide the optimum quality of food to the people. Dairy is becoming a stronger industry day by day on the basis of this quality need for several milk and livestock products. Every livestock industry has an irreplaceable demand for quality fodder to meet the need of the animals for maintenance and quality productivity on the maximum scale. The following article gives an overall idea about the status of fodder production in India as well as the seasonal variation, quality and criteria for selection for a green fodder crop to a farmer."

About 46% of the geographical area in India is under cultivation, and in intensively populated states like Punjab, Haryana and West Bengal, it is as high as 83, 82 and 69%.(Mukherjee and Maity 2008). With the improvement in human food production in India since 1965 onwards, there has also been improvement in milk and egg production. Which has kept pace to an extent with the increasing rate of human population and with the slow and steady rate of improvement in the standard of living of a fairly big sector of human population? In India, land utilization for growing fodder is very negligible; in about 5% of the cultivated area fodder crops are grown (ICAR Handbook of Agriculture 2014). At present land has to provide sustenance for about 1000 million human beings and in addition, it has to maintain a large number of animals of low productivity. India being the leading milk producer in the world has a very good scope for dairy industries to thrive. But the principal resource for development of a dairy sector is provision of good quality feed and fodder to the animal throughout the year, which is apparently a problem. This document provides information about some of the available green fodder

throughout the year and there quality standards for convenience to the farmer.

STATUS OF FODDER, ITS DEMAND AND SUPPLY

The forage resources of India are mainly derived from crop residues, cultivated forages and grazing from pastures and grasslands. The country has about 4.9%, i.e, 8.3 million ha area under cultivated forages (Mukherjee and Maity 2008). The requirement of fodder is mainly governed by the density of livestock in the area and secondly by management levels and climatic conditions. The fodder resources with present productivity levels are not sufficient to meet the demand of this huge livestock population.

Table No.1 : Projected demand, supply and deficits of forage in the country

	Supply (mt)		Demand(mt)		Deficit%	
Year	green	dry	green	dry	green	dry
2003	387.7	437.3	1006	560.1	61.51	21.81
2005	389.8	441.6	1021	568.0	61.83	22.12
2010	395.2	452.7	1057	588.2	62.63	22.91
2015	400.5	464.0	1095	609.2	63.44	23.72
2020	406.0	475.7	1134	630.9	64.26	24.57
2025	411.5	487.6	1174	653.3	65.10	25.44

Source:- Draft report on fodder during the 'X' plan submitted to planning commission (2001)

SEASONAL DISTRIBUTION OF GREEN FODDER

The main crop seasons followed in India are *Kharif* or Summer and *Rabi* or Winter. The main crops that can be grown during these seasons are-

- Annual graminaceous summer growing-
  - Sorghum (*Sorghum bicolour* L. Moench.)
  - Sudan grass (*Sorghum sudanense* L.)
  - Maize (*Zea mays* L.)
  - Teosinte (*Zea Mexicana* L.)
  - Pearl millet (*Pennisetum americanum* L. Schum)
  - Deenanath Grass (*pennisetum pedicellatum* Trin.)
- Annual graminaceous winter growing-
  - Oats (*Avena sativa* Linn.)
  - Cowpea (*Vigna unguiculata* Linn. Walp)
  - Rice bean (*Vigna umbellate* Ohwi and Ohashi)
  - Moth bean (*Phaseolus accontifolius* Jacq.)
  - Soybean (*Glycine max* L. Merril)
  - Velvet bean (*Mucuna pruriens* L. DC)

- Guar or cluster bean (*Cyamopsis tetragonoloba* L. Taub)

- Annual leguminous winter growing
  - Berseem or Egyptian clover (*Trifolium alexandrinum* Linn.)
  - Senji (*Melilotus perviflorus* Desf.)
  - Metha or Fenugreek (*Trigonella foenumgraecum* L.)
  - Vetches (*Vicia spp.*)
  - Indian Vetch/ Lathyrus (*Lathyrus sativus* L.)
- Perennial graminaceous summer growing
  - Hybrid Napeir (*Pennnisetum purpureum* X *Pennisetum americanum*)
  - Guinea grass (*Panicum maximum* Jacq.)
  - Para grass (*Brachiara mutica* Stapf.)
  - Pangola grass (*Digitaria decumbens* Stent)
  - Doob grass (*Cynodon dactylon* Pers.)
  - Anjan grass (*Cenchrus ciliaris* Linn.)
  - Black Anjan (*Cenchrus setigerus* Vahl.)
  - Rhodes grass (*Chloris gayana* kungh.)
  - Setaria grass (*Setaria anceps* Staph. ex Massey)
  - Thin Napier (*Pennisetum polystachyon* L. Schult)
  - Elephant or Napier grass (*Pennisetum purpurium* Schumach)
  - Sadabahar (*Andropogon gayanus* Kunth.)
  - Marvel grass (*Dicanthium annulatum* Stapf)
  - Musal (*Ilsemia laxum* Hack)
  - Dhawlu or Guria (*Chrysopogon fulvus* Chiov)
- Perennial graminaceous winter grown-
  - Canary grass (*Phalais tuberose* L.)
- Perennial leguminous summer growing
  - Stylo (*Stylosanthes hemata* L.)
- Perinnial leguminous winter growing
  - Lucerne (*Medicago sativa* L.)

(*Forage crops production and conservation, Mukherjee and Maity, 2008*)

SELECTION OF FORAGE SPECIES

In the tropics, a large number of fodder species, acclimatized to the climate are naturally seen. In addition, many improved species were introduced and now seen naturalized here. From among the diverse number of forage species, farmers can select one or more according to their requirement and according to the nature of land. The main considerations while selecting a species is discussed below.

Grass or Legume?

Most of the forage crops are either grasses or legumes. The cereal or grasses are rich in fibre or carbohydrates that are essential for energy production, while the

legume fodders supply a greater amount of proteins and fats that are essential for body building and milk production in dairy animals.

Hence proper formulation and balance is necessary while feeding the animals. A high productive dairy cow must be supplied with sufficient amount of protein and essential fatty acids, while a drought animal requires greater amount of carbohydrates.

Nutritive value

Cultivable forage crops must have high nutritive value. Nutritive value of feed is determined by its ability to provide the nutrients required by an animal for its maintenance, growth and reproduction. Nutritive value is a function of the feed intake and the efficiency of extraction of nutrients from the feed during digestion. Feeds of high nutritive value promote high levels of production manifested by live weight gain. Nutritive value is assessed in terms of energy availability, protein content, minerals, vitamins and freedom from anti-nutrient factors. Proximate analysis devised long ago by the Weende Experimental Station in Germany is still made use for assessing nutritive value. Five fractions- Crude Protein (CP), Crude Fibre (CF), Nitrogen Free Extract (NFE), Ether Extract (EE) and Ash are involved in the analysis. Although the analysis does not usually describe the actual chemical composition of the forage, it still serves as a good index to nutritive value of feeds.

1. ***Crude protein.*** It gives an approximate value of protein content in the forage. It is obtained by multiplying the nitrogen percentage in the feed determined by Kjeldahl analysis with the factor 6.25. For ruminant animals, protein quality is not much importance as rumen can synthesize most necessary amino acids, if the nitrogen content is adequate. Therefore, nitrogen content or crude protein content can be taken as a primary criterion for assessing protein content of the feeds. For dairy cows, the feed actually ingested should have at least 1.1 % nitrogen (CP-6.88%) for maintenance, 1.6% (CP10%) for beef production and 1.9% (CP-11.88%) for dairy cows (Humphreys, 1978). By ensuring a good grass legume balance in the pasture, protein requirement can be met easily.
2. ***Crude fibre.*** Crude fibre refers to that portion of feed insoluble in hot diluted sulphuric acid and diluted sodium hydroxide solution. Fibre is essential for rumination, that is the growth and development of rumen microbes and

production of *Volatile Fatty Acids* (VFA). It is often observed that part of crude fibre is digestible.

3. ***Ash***. Ash in the sample is determined by igniting samples until they are free of carbon. This gives an indication of minerals present in the sample.
4. ***Ether extract***: This gives an estimate of crude fat content. It is measured as diethyl ether or petroleum ether extracted material including fats, oils, fatty acids and resins.
5. ***Nitrogen Free Extract****:* This is obtained by subtracting CP, CF, EE and ash content values from the original sample dry weight. It represents the digestible carbohydrates present in the feed. Animals consume forages in varying quantities. Voluntary intake and nutritive values of the forages are correlated. *Voluntary intake* is the quality of forages eaten by a livestock during a period of time when the forage is offered at pleasure. It is usually expressed based on metabolic body weight. Metabolic body weight, which is live weight raised to 0.75 power (LW kg^0.75), is used to correct the differences in intake due to differences in species or size of animals. The unit is g/kg LW^0.75 body weight. Voluntary intake is governed by many factors such as, palatability, nutrient value of fodder, leaf: stem ratio, legume content in the pasture, grazing system and thickness of sward. A thick sward provides a larger intake per bite than loose, trailing plants.

Digestibility of forage crops differs. The quantity of feed digested expressed as a percentage of the feed consumed is termed as *digestibility co-efficient.* However as it is difficult to determine true digestibility coefficient, in practice, *apparent digestibility co-efficient* is determined, which is given by:

$$\text{Apparent Digestibility Co - efficient} = \frac{\text{Forage consumed - Faecal matter X100}}{\text{Forage consumed}}$$

SSome plant organs are more digestible than others and some structures, for example: thorns, may limit intake. Compared to leaf sheaths and stems, young leaf blades are superior in digestibility. Flowers are variable in quality. Therefore, leafiness is taken as an index of desirable quality. Grasses with a long season of inflorescence production are considered inferior. Presence of tannins is an indication of poor quality, which reduces the

digestibility of both herbage and protein. Presence of tannins is often evident as brownish, reddish tinges in juvenile growth.

Table No.2: Chart of nutritional qualities of some important fodders

Fodder	CP (%)	EE (%)	CF (%)	Ash (%)	NFE (%)
1. Anjan grass	4.82	1.62	33.20	9.36	51.00
2. Barley	11.5	1.9	11.5	11.4	43.4
3. Berseem	15.80	1.4	28.5	16.00	38.3
4. Butterfly pea	11.80	0.70	33.80	9.00	44.70
5. Citronella grass	8.95	1.75	30.34	3.54	55.42
6. Cowpea	15.77	2.39	20.11	16.94	30.43
7. Deenanath grass	6.5	3.2	35.8	40.1	14.4
8. Dub/Bermuda grass	4.90	1.20	39.7	8.1	46.1
9. Guar	14.1-18.9	1.2-2.2	22.7-31.9	8.2-17.0	37.6-48.3
10. Guinea grass	7.7	1.7	37.3	13.9	39.4
11. Khesari/Lathyrus	15.45	2.7	28.76	19.73	33.36
12. Lemon grass	6.6	1.01	34.3	6.20	51.89
13. Lucerne	23.9	4.3	25.4	11.1	35.3
14. Maize	6.74	2.09	85.95	8.15	47.07
15. Marvel grass	4.27	1.46	38.90	10.64	44. 70
16. Methi	15.7	2.1	13.1	8.80	42.4
17. Moth bean	10.15	3.23	16.54	16.99	53.1
18. Napier	10.5	6.4	27.0	11.1	45.00
19. Oats	5.7	1.8	35.7	8.9	47.9
20. Pea	17.38	2.52	24.19	12.90	43.01
21. Pearl millet	6.8-12.8	0.9-1.8	29-34	8.23	41-52
22. Rhodes grass	9.4	1.2	36.20	11.1	42.10
23. Rice bean	16.9	1.9	30.6	7.8	43.8
24. Rye grass	12.2	3.6	13.3	7.8	63.1
25. Sorghum	7.75	1.73	32.36	8.55	49.61
26. Soybean	17.17	2.9	27.35	7.74	44.79
27. Subabul	17.37	2.82	26.10	11.55	42.16
28. Sudan grass	9.5	1.92	33.18	12.36	43.04
29. Sunhemp	14.2	2.5	33.3	8.00	42.00
30. Sweet clover	23.00	2.5	27.4	13.60	33.50
31. Teosinte	4.5	1.2	32.2	10.8	51.3
32. Velvet bean	15.10	2.10	19.30	14.90	48.60
33. White clover	21.09	2.34	22.61	6.05	47.91

(*Source:-Nutrient Composition of Indian Feeds and Fodder, ICAR*)

Hence mainly based on these two parameters a farmer can select a forage species according to the season.

SUMMERY AND CONCLUSION

The country inhabits 15% of world livestock population on 2% geographical area, which itself is an indicative of the extent of livestock pressure on our resources in comparison to other countries. Due to competing land use, area under cultivated fodder is static to around 8.4 mha since last two decades. This sector with its burden of limitation can hardly compete with other sectors of agriculture. Hence, only option available is to catalyze vertical increase in the fodder production to meet out the ever increasing demand of the fodder for economic livestock production. The knowledge of the quality and year round availability of fodder will help a farmer to select a particular fodder in the cropping system and to improve its production. At present the productivity of cultivated fodder crops is low, due to least attention and allocation of minimal production resources on one hand and non availability of the production techniques to stake holders involved in the forage resource development on the other. This needs to be tackled by educating the farmers about the production packages of fodder crops like selection of appropriate forage species, varieties and management techniques to sustain forage yields and soil fertility.

Towards a healthy India: Milk, milk products and safety concerns

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India is the highest producer of milk in world (132.7 million-ton in 2013) and Indian dairy industry has shown a much higher growth rate than global average. India is also one of the top producers of food grains and fruit and vegetables also. But despite of this astonishing picture India is also home of vast undernourished population. India host the one-third of the world's undernourished children. According to the third National Family Health Survey one-third of Indian children are born with low birth weight, 45 percent of children below three years of age are stunted, 23 percent are wasted, and 40 percent are underweight. Under nutrition among adults is substantial too: Around one-third of all Indian women have body mass index (BMI) below 18.5. Micronutrient deficiencies are rampant among children and adults, with 79 percent of children, 56 percent of women, and 24 percent of men being anaemic. One young child in three continues to be at risk for iodine deficiency (Gillespie, Harris and Kadiyala, 2012). Despite of government's substantial effort throughout the last decade this scenario has changed only a little. As a reason serious blame can be attributed to the factors like lack of serious effort to make people aware, poorly developed policy approach, poverty among the very large population thus limited access to the food in required quantity and quality, lack of nutritious processed food staff etc. With the high rate of inflation thus increasing prices of basic food material it is becoming increasingly hard for common people even maintain their present diet thus ensuring high nutritional standard of Indian population is seem to be distant goal. But glistering thing in this overall glossy picture is the existence of a healthy dairy sector with a growth rate of 4.3 per cent per annum which is double than average world growth rate in this sector. With a production of 132.7 million ton in last year and an estimated higher production in ongoing year this sector can be used to boost up the nutritional

standard of Indian people by making available good quality milk and milk product. Given the potential of Indian dairy sector it is not an impossible task.

NUTRIENTS IN MILK

Milk can make a significant contribution to the required nutrient intakes for calcium, magnesium, selenium, riboflavin, vitamin B12 and pantothenic acid (Table 1). Food of animal origin, including milk and dairy products, can be an important source of zinc and vitamin B12 in children at risk for micronutrient deficiencies (Neumann, Harris and Rogers, 2002). Milk is low in sodium. Bioavailability of some nutrients in milk, for example calcium, is high compared with that in other foods in the diet. Milk does not contain substances that inhibit mineral bioavailability, such as phytates and oxalates. In addition, milk is thought to contain constituents that enhance mineral absorption, such as lactose and certain amino acids. Milk fat contributes about half of the energy in whole milk. Thus animal milk can play an important role in the diets of infants and young children in populations with a very low fat intake (Michaelsen *et al.,* 2011), where the availability of other animal-source foods (ASF) is limited. Milk lipids are carriers of fat soluble vitamins. Milk fat contains approximately 400 different fatty acids, which make it the most complex of all natural fats (Mansson, 2008). Milk contains high-quality protein including all the essential amino acids needed by humans. But some limitation associated with cow milk is there. Cow milk does not contain appreciable amounts of iron (Dror and Allen, 2011). Consumption of fresh, unheated cow milk by infants prior to 12 months of age is associated with faecal blood loss and lower iron status (Griffin and Abrams, 2001). Compared with breast milk, cow milk also presents a high renal solute load to infants, owing to its higher contents of minerals and protein. Thus according to WHO guidelines, no undiluted cow milk should be given to infants up to 12 months of age unless accompanied by iron supplements or iron-fortified foods, although dairy products such as cheese and yoghurt may be fed to infants more than six months old (WHO, 2004).

Role milk products can play in physiological growth

Nutrition and health in the first two to three years of life are crucial for growth and development of children, with most limited growth occurring during this time and extremely important for Indian children's particularly for low and medium economic status family given the present scenario of malnutrition in India.

Table 1: Nutrient content of full fat milk (per 100 g)

Nutrient	Whole milk*	Nutrient	Whole milk*
Water (g)	87.69	Zinc (mg)	0.38
Energy (kcal)	64	Copper (mg)	0.01
Energy (kJ)	268	Manganese (mg)	0.004
Protein (g)	3.28	Selenium (mcg)	2
Lipid Total (g)	3.66	Vitamin C (mg)	1.5
Ash (g)	0.72	Thiamin (mg)	0.038
Carbohydrate (g)	4.65	Riboflavin (mg)	0.161
Calcium (mg)	119	Niacin (mg)	0.084
Iron (mg)	0.05	Pantothenic acid(mg)	0.313
Magnesium (mg)	13	Vitamin B6 (mg)	0.042
Phosphorus (mg)	93	Folate (µg)	5
Potassium (mg)	151	Vitamin B12 (µg)	0.36
Sodium (mg)	49	Vitamin A (RAE)	33

**Source FAO, 2013*

Stunting is associated with increased child morbidity and impaired cognitive development. Stunting, along with low birth weight, is also a risk factor for chronic disease in adulthood (Popkin, Horton and Kim, 2001). Cow milk is a source of micronutrient vitamin B12, commonly deficient in Indian populations and can thus help to improve children's nutritional status. Furthermore, milk can be used as a fortification vehicle for micronutrients. Nutritionally deprived children benefited more from supplementation than their better-fed peers, and teenagers.

Effect of milk and dairy products on growth of undernourished children

Studies from developing countries reported a positive association between milk consumption and linear growth in preschool children. Milk consumption is significantly associated with higher height-for-age as compared to intakes of meat, eggs, fish and poultry. Although there is argument over the effect of milk but commonly milk appears to have a positive effect on growth among nutritionally or socio-economically disadvantaged children. The strongest effects may be seen on the growth of children with existing under nutrition and more apparent during the first few years of life (de Beer, 2012).

Milk and dairy products in the diets of well-nourished children

Milk promotes linear growth in well-nourished children also though gains are not always visible like in undernourished children. Long-term avoidance of cow milk was associated with small stature and poor bone health (Black *et al*., 2002). Thus to continure in their present state of nutritional health well nourished children also should not stop to take easily available milk and milk products.

Milk and dairy products in countering vitamin D Deficiency in India

Vitamin D deficiency prevails in epidemic proportions all over the Indian subcontinent, with a prevalence of 70%–100% in the general population. Vitamin D deficiency is likely to play an important role in the very high prevalence of rickets, osteoporosis, cardiovascular diseases, diabetes, cancer and infections such as tuberculosis in India (Ritu and Gupta, 2014). In India, widely consumed food items such as dairy products are rarely fortified with vitamin D. Milk is generally boiled for several minutes before consumption. Vitamin D is stable during cooking up to 200 °C. But thermal stability of vitamin D is an inverse function of both temperature and time. To overcome this problem the only way is to use food fortification and given the habit of using of milk in their daily diet especially in rural areas it may serve as a best medium to supply vitamin D to common population. But Vitamin D fortified milk from *Amul* is the only fortified milk product found in the general market. It is 4.5% fat, homogenized milk fortified with calcium 150 mg, vitamin A 75 µg and vitamin D 0.5 µg (20 IU), etc., per 100 mL. But Cost per litter is INR 48 (as on 12 January 2013) as opposed to the cost of unfortified milk (INR 30).

QUALITY CONCERNS ABOUT MILK

Milk is highly perishable commodity and care should be taken to preserve the quality of the milk from the time of milking, to processing, transport and up to the point of consumption. Proper hygienic have to be maintained in all the processes before milking, during collection, and also during the processing. Temperature should be maintained below 4 degree Celsius during transportation, distribution *etc.* till it reaches the consumers. If any lacuna occurs in the entire process, acidity in milk will increase which is likely to affect one's health. Thus preservation of milk is a tedious job and costly also. Farmers in our country often added certain cheap neutralizers like Peroxide and Carbonates to ensure the milk retains its quality. But this is prohibited as per the FSSA Act as it is injurious to health.

BACTERIOLOGICAL ANALYSIS

Pathogenic bacteria like *E. coli* (above threshold level), *Coliform* bacteria, *Salmonella*, *Listeria* may be found in the milk of daily use.It can be dangerous if it exceeds the permitted limit.

Total count Bacteria

Considered to be of non-pathogenic (harmless) origin but when it exceeds the FSSAI standard limits, it is indicative of unhygienic processing of milk bringing down the shelf life and increasing the acidity very fast. If such milk is consumed it will lead to indigestion and related ailments.

Antibiotic Residue

If the animal is treated with antibiotic infusion for mastitis, milk should not be used for 4 days after the animal is cured, as the residue of antibiotic will be there in the milk. It is not advisable to consume this milk that will cause allergic sensitivity, skin rashes *etc.* Very often this norm is neglected and not adhered to by the cattle farmers.

Other safety criteria

Milk should be free from toxic material like heavy metal, pesticide residue, Melamine and aflatoxin.

Melamine: Synthetic chemical used to adulterate skim milk powder to enhance protein content to fetch better price. This is very injurious to health. If such milk is consumed, melamine poisoning will occur. Melamine poisoning will affect the kidney and the urinary bladder — melamine should be totally absent in the milk.

Aflatoxin: Feeding the animal with feed that is fungal (aflatoxin) infected, it will get excreted in the milk. This should not be present in the milk as per WHO Standard. When such milk is consumed it will act like a cumulative poison and it will damage the liver and cause cirrhosis.

Heavy metal – Lead

It should be absent in the milk and if lead laden milk is consumed it will cause cumulative poison and develop cancer.

Pesticide residue: It should conform to standards prescribed in PFA now FSSAI. If it exceeds the prescribed limits it will cause peptic ulcers and even cancer after prolonged usage.

ADULTERATION IN MILK

Milk is adulterated to earn better profits. Not only cattle farmers but also commercial dairies also add the adulterants knowingly and unknowingly. Commonly used adulterants are Salt, Cane Sugar and Urea (used in fertilizers and farming), which are easily available in the villages; it is added to the milk to boost Solid Not Fat (SNF) in milk to get a better price. The processed milk should be free from all such adulterants.

Expected role of governments to boost nutritional security through milk and milk products

Government need to strong play in any dairy-industry development programme, particularly one that includes explicit nutritional objectives. Important aspects

of the government's role include the following:

- Identification of national priorities and national needs in relation to consumption and nutrition, support to small-scale vs. large-scale production, public vs. private investment etc. These priorities will affect the scale and shape of investment in dairy and nutrition.
- Identification of national nutritional challenges, promoting measurement of nutritional status and providing dietary guidelines.
- Investment in basic infrastructure, roads, electricity and water supplies to increase the practical scope of dairy programmes.
- Policies, laws and regulations that support nutrition-sensitive dairy-industry development and the provision of safe milk and dairy products, alongside other nutrition-sensitive agricultural actions.
- Promotion of collaboration between the government agencies responsible for livestock development and those responsible for human health and social welfare.
- Encourage investment from both public and private sectors in sustainable dairy-industry development programmes.

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Modern Foods – Bitter Truths

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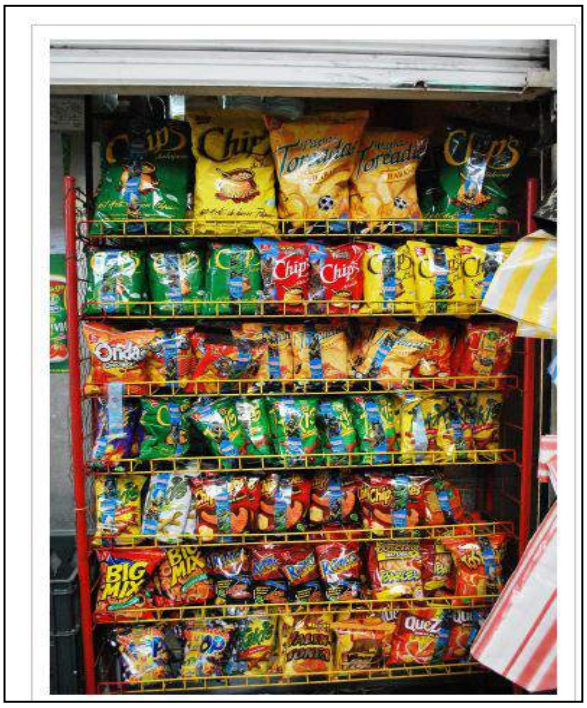
Food processing has been started in early life of human being that when he start cooking. There are different kinds of processing practiced at kitchen in all homes viz., ferment, grind, soak, chop and dry. Traditional processing was aimed to make food more digestible and to preserve it for use during times when food isn't readily available. Pickle makers, cheese makers, distillers, millers processed the raw ingredients into delicious foods that retained their nutritional content over many months or even years, and kept the profits on the farm and in the farming communities where they belonged. Unfortunately, in modern times, we have substituted local artisanal processing with factory and industrial processing, which actually diminishes the quality of the food, rather than making it more nutritious and digestible. Industrial processing depends upon sugar, white flour, processed and hydrogenated oils, synthetic food additives and vitamins, heat treatment and the extrusion of grains.

EXTRUDED PRODUCTS

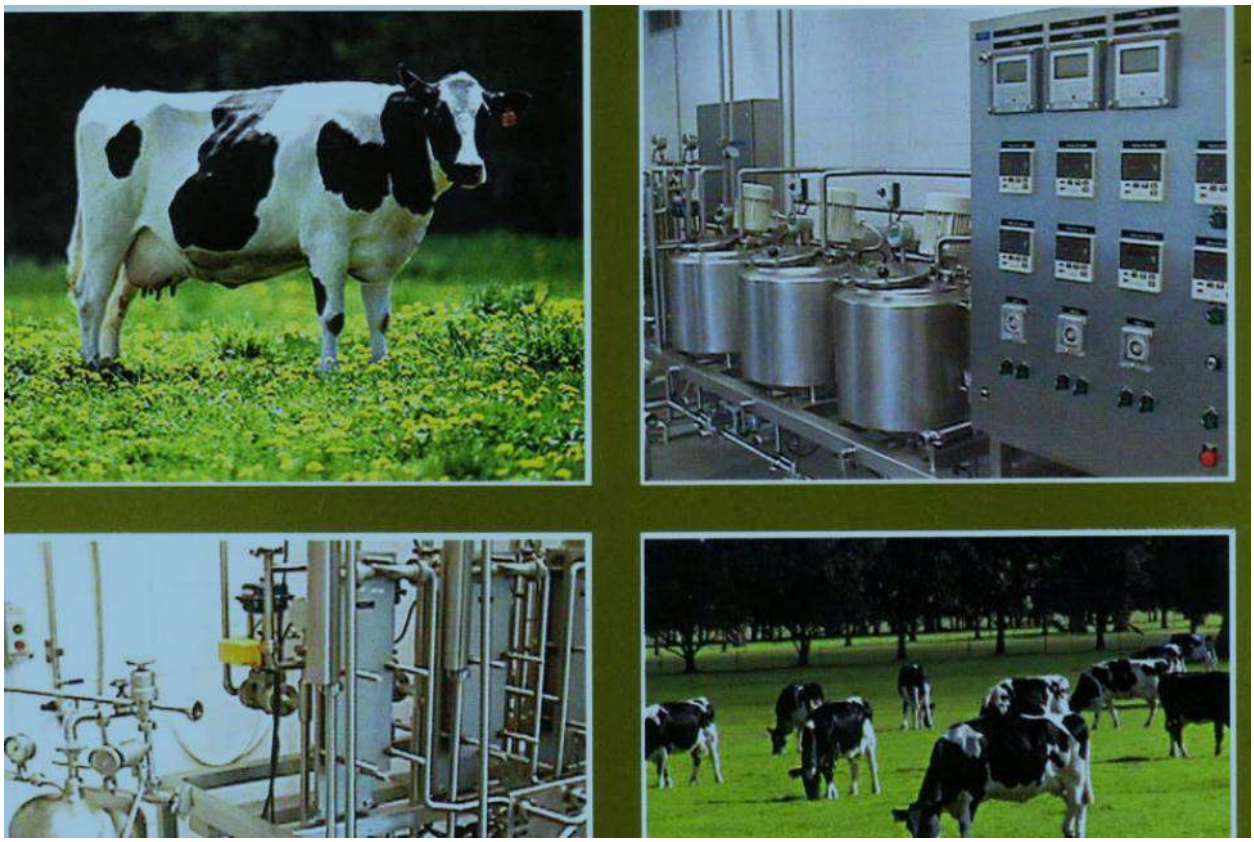
We can have glance here about the processing involved in the day to day



human life viz., extruded products, processed milk and fruit juice in cartons. Snacks like kurkure , cheetos, etc most preferred by our children and adults are extruded products. Grains are mixed with water, processed into a slurry and placed in a machine called an extruder. The mixture of grains and other ingredients

are forced out of a tiny hole at high temperature and pressure, which shapes them into little o's or flakes or shreds. These products are then subjected to sprays that give a coating of oil and sugar to seal off the cereal from the ravages of milk and to give it crunch. Extrusion is the process, where the grains treated with very high heat and pressure, and destroys much of their nutrients. It denatures the fatty acids; it even destroys the synthetic vitamins that are added at the end of the process. The amino acid lysine, a crucial nutrient, is especially damaged by the extrusion process. There are unpublished studies about these extruded products showing the dangerous effects on animals and humans.

One unpublished research found that the extrusion process turns the proteins into neurotoxins. Stitt, 1942 conducted a study with four sets of rats given special diets.1 One group received plain whole wheat grains, water and synthetic vitamins and minerals. A second group received puffed wheat (an extruded cereal), water and the same nutrient solution. A third set was given water and white sugar. A fourth set was given nothing but water and synthetic nutrients. The rats that received the whole wheat lived over a year on this diet. The rats that got nothing but water and vitamins lived about two months. The animals on a white sugar and water diet lived about a month. The study showed that the rats given the vitamins, water and all the puffed wheat they wanted died within two weeks—even before the rats that got no food at all. These results suggest that there was something very toxic in the puffed wheat itself. Proteins are very similar to certain toxins in molecular structure, and the pressure of the puffing process may produce chemical changes that turn a nutritious grain into a poisonous substance. When we put cereals through an extruder, it alters the structure of the proteins. Zeins, which comprise the majority of proteins in corn,



are located in spherical organelles called protein bodies. The scientific literature does contain one study on extruded grains, which investigated changes in protein body, shape and release of encapsulated alpha-zeins as a result of the extrusion rocessing. Researchers found that during extrusion, the protein bodies are completely disrupted and the alpha-zeins dispersed. The results suggest that the zeins in cornflakes are not confined to rigid protein bodies but can interact with each other and other components of the system, forming new compounds that are foreign to the human body. The extrusion process breaks down the organelles and disperses the proteins, which then become toxic. When the proteins are disrupted in this way, it can adversely affect the nervous system, as indicated by the cornflake experiment.

GRUEL IS THE BEST

As conventional, gruel made from grains provide excellent nourishment at an economical price. Grains should be cut or rolled and then soaked overnight in a warm, acidic medium to neutralize the many anti-nutrients naturally occurring in grains, such as irritating tannins, digestion-blocking enzyme inhibitors and

mineral-blocking phytic acid. This treatment can also gently break down complex proteins in grains. Hence we must soak our grains in warm water plus one tablespoon of something acidic, like whey, yoghurt, lemon juice or vinegar. The nutrients in the dairy fats are needed to absorb the nutrients in the grains. Without the fat-soluble vitamins A, D and K2, absorption of minerals in food is difficult. Furthermore, the fats in butter and cream slow down the release of glucose into the bloodstream, so that blood sugar remains stable throughout the morning.

MILK

Milk is one of nature's most perfect foods. Most of our milk comes from a sacred animal, the cow. Today, however, in the farming system, we imprison cows indoors for their entire lives; The confinement environment make these cows uncomfortable, We breed them to give huge amounts of milk, and give them hormones to increase milk production as well. These cows produce large quantities of watery milk with only half the amount of fat compared to milk produced by old-fashioned cows eating green grass. Then this milk is transferred to plants for processing. Inside the plants, the milk is completely remade. Milk is fractionated into fat, protein and various other solids and liquids with advanced equipment. And these are recombined at specific levels set for whole, low fat and no-fat milks. Of the reconstituted milks, whole milk will most closely approximate original cow's milk. Apart from the fluid milk, it goes for preparation of butter, cream, cheese, dried milk and other milk products. The dairy industry promotes low fat milk and skim milk because they can make more money on the butterfat when used in ice cream. When they remove the fat to make reduced-fat milks, they replace it with powdered milk concentrate, which is formed by high temperature spray drying. If the temperature is 150^0C (over the boiling point), the milk is considered ultrapasteurized. This ultrapasteurized milk will have a distinct cooked milk taste, but it is sterile and shelf stable. It may be sold in the refrigerated section of the supermarket so the consumer will think it is fresh, but it does not need to be. The milk is also homogenized by a pressure treatment that breaks down the fat globules so the milk won't separate. Once processed, the milk will last for weeks, not just days. This causes a lot of nitrates to form, and the cholesterol in the milk becomes oxidized. Contrary to popular

opinion, cholesterol is not a demon but it is very essential to our health. But consumption of oxidized cholesterol is a devil. Evidence indicates that oxidized cholesterol can initiate the process of atherosclerosis. Powdered milk is added to reduced-fat milks and milk products to give them body. Consumption of reduced-fat milk or yoghurt having oxidized cholesterol, they will initiate the process of heart disease.

FRUIT JUICES IN CARTON

Juice processing plant is completely automated and can process in tonness of fruits per day to produce frozen concentrate. To produce juice, various acid sprays were spraying over the fruits to improve the peel quality and increasing juice yield. These spray components were added to extract as much juice as possible. In olden days, the fruit trees were sprayed heavily with pesticides called cholinesterase inhibitors, which are very toxic to the nervous system. When they put the whole fruits into the vats and squeeze them, all that pesticide goes into the juice. Then they add acids to get every single bit of juice out of these oranges. So orange juice may be very toxic. This may be one reason that consumption of fruit juice is associated with increased rates of dementia.

Researchers have identified heat resistant fungus in processed juices. They found that seventeen percent of Nigerian packages of orange juice and twenty percent of mango and tomato juices contained these heat-resistant fungi. They also found *E. coli* in the orange juice; it was pressure resistant and had survived pasteurization. So there is plenty of danger from contamination in these pasteurized juices. One research study found that agents producing mutagenicity and cytotoxicity present in processed organge juice. Another study, gel filtration and high performance liquid chromatography were used to obtain mutagenic fractions from heated orange juice.

READY TO PREPARE SOUPS

Soup bases and sauces available in super markets having artificial meat-like flavors that mimic natural soup prepared at home. Usage of emulsifier for thickening effects decease the health benefits of consumer. Humans actually have receptors on the tongue for glutamate—it is the protein in food that the human body recognizes as meat–but the glutamate in MSG has a different configuration, which cannot be assimilated properly by the body. Any

protein can be hydrolyzed (broken down into its component amino acids) to produce a base containing MSG. now a days all the fast foods existing with MSG and artificial meat flavors, which beguile the consumer into eating bland and tasteless food.

Homemade soups in road side as well as in hotels are usually made by mixing water with a powdered soup base made of hydrolyzed protein and artificial flavors, and then adding chopped vegetables and other ingredients. The industry even thinks it is too costly to just use a little onion and garlic for flavoring–they use artificial garlic and onion flavors instead. It's all profit based with no thought for the health of the consumer.

Similarly the processed vegetarian foods are also loaded with these flavorings. Soy foods are loaded with MSG. Unfortunately the labeling system also won't help us because if the mix is less than fifty percent MSG, they don't have to indicate MSG on the label. MSG is a neurotoxic substance that causes a wide range of reactions in humans, from temporary headaches to permanent brain damage. It is also associated with violent behavior. Alzheimer's, brain cancer, seizures, multiple sclerosis and diseases of the nervous system, and one of the chief culprits is the flavorings in our food. Ninety-five percent of processed foods contain MSG. Even this is added in to the baby foods in the name of hydrolysed protein.

REFINED OILS

Crude vegetable oil which is dark, sticky and smelly is subjected to terrible processing to produce clean looking cooking oils, margarine, shortening and spreads. The steps involved in processing usually include degumming, bleaching, deodorizing, filtering and removing saturates to make the oils more liquid. In the process, the nutrients and antioxidants disappear but not the pesticides. Most processors also add a hexane solvent in order to squeeze the very last drop of oil out of the seeds. Caustic refining, the most widely used process for oil refining, involves adding very alkaline, chemicals to the oil. In order to make a solid fat out of liquid oil, manufacturers subject the oils to a process called partial hydrogenation. The oil is extracted under high temperature and pressure, and the remaining fraction of oil is removed with hexane solvents. Manufacturers then steam clean the oils, a process that removes all the vitamins, transfatty acids and all the antioxidants

but, the solvents and the pesticides remain. These oils are mixed with a nickel catalyst and then, under high temperature and pressure, they are flooded with hydrogen gas. What goes into the reactor is a liquid oil; what comes out of that reactor is a smelly mass resembling grey cottage cheese. Emulsifiers are mixed in to smooth out the lumps, and the oil is then steam cleaned once more, to get rid of the horrible smell.

Bleaching is the process to get rid of the grey color. At this point, the product can be called "pure vegetable shortening." To make margarines and spreads, artificial flavors and synthetic vitamins are added. But the government does not allow the industry to add synthetic color to margarine–they must add a natural color, such as annatto–a comforting thought. The margarine or spread is then packaged in blocks and tubs and advertised as a health food. Saturated fat is the type of fat found in such foods as lard, butter and coconut oil. Saturated fat molecules are straight, so they pack together easily. That is why saturated fats are solid at room temperature. Unsaturated fats have a little bend at each double bond, with two hydrogen atoms sticking out on the same side. And when that molecule gets incorporated into cells, the body wants those two hydrogen atoms to be on the same side of the carbon chain, forming an electron cloud; that is where controlled chemical interactions take place. During the process of partial hydrogenation, one of those hydrogen atoms is moved to the other side, causing the molecule to straighten out so that it behaves chemically like a saturate—although *bio*chemically it behaves very differently. The original, unsaturated molecule is called a "cis" fatty acid, because the two hydrogens are together, and then it becomes a *trans* fatty acid, because the two hydrogens are across from each other ("*trans*" means "across"). The more *trans* fatty acids in the meal, the partially hydrogenated cells become more and the more disorder will be on the cellular level. All of the margarines, shortenings and even low-*trans*-fat spreads are made with these harmful ingredients. We can found in chips and crackers, and most restaurants use them for cooking fries.

Many diseases have been associated with the consumption of *trans* fatty acids—heart disease, cancer, and degeneration of joints and tendons. The only reason that we are eating this stuff is because we have been told that the competing saturated fats

and oils—butter, lard, coconut oil, palm oil, tallow and suet—are bad for us and cause heart disease.

FOOD MADE AT HOME IS HEALTHY

Food preparation is actually a sacred activity. It is one of the most important and least understood activities of life that the feelings that go into the preparation of food affect everyone who partakes of it. This activity should be unhurried, peaceful and happy because the energy that flows into that food impacts the energy of the receiver. The person preparing the food may be the only one in the household who is spiritually advanced. An active charge of happiness, purity and peace will pour forth into the food from him, and this pours forth into the other members of the family and blesses them. To be healthy, we need to prepare our own food, for ourselves and our families. We can return to good eating practices one mouth at a time, one meal at a time, by preparing our own food and preparing it properly.

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Dairy Cattle communication behaviour

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Communication can be defined as an exchange of a signal is between a sender and receiver to the benefit of both parties (Bradbury and Vehrencamp, 1998). Information transmission between two individuals can pass in four channels: acoustic, visual, chemical, and electrical. Cattle communicate with specific chemical, mechanical, optical, auditory, and electrical signals, as well as with nonspecific signals that accompany respiration, locomotion, or feeding. The signals are received by means of the organs of sight, hearing, olfaction, taste, and skin sensitivity; thermoreceptors; and electroreceptors. The generation and reception of signals form communication channels (auditory, chemical) between organisms for the transmission of information of varying physical or chemical nature. Information entering through different channels of communication is processed in different parts of the nervous system and is then integrated in the higher nerve centres, where the response reaction of the organism is formed. Without communicatory signals, courtship and mating, care of the young, formation of groups (flocks, herds, hives, colonies), and regulation of relationships between individuals in a group (territoriality, hierarchy) would be impossible. It also depends on changing environmental conditions and biological rhythms.

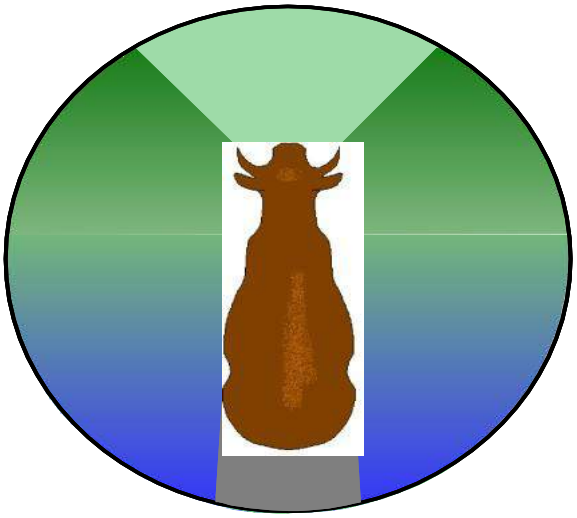
Ways of communication in cattle:

There are four main ways of cattle to communicate with each other viz. a) acoustic b) visual c) chemical and d) tactile Acoustic signals have characteristics that make them particularly suitable for communication, and virtually all animal groups have some forms which communicate by means of sound. Sound can travel relatively long distances in air or water, and obstacles between the source and the recipient interfere little with an animal's ability to locate the source. Both amplitude and

frequency modulation can be found in sounds emitted by animals. Cattle sensitivity to noise varies with age: heifers and the bull-calves react quicker to new sounds than cows and bulls (Lanier et al, 2000), but the animal's temperament is an important variation factor. Furthermore, cattle adapt quickly to their usual sound environment. They identify and adjust to the daily noises of the farm (milking room, tractor, and radio) and only new or unexpected noises lead to fearful reactions, high pitched sounds (high frequencies) in particular. Low-pitched sounds (low frequencies) tend to soothe the animal (Arave, 1996). Cattle use their voices to communicate between themselves. The sounds emitted are varied: mooing, grunting, and bellowing and they are associated with distinct meanings (Hall, 2002): warnings, threats, a call to fight, a provocation to fight, the call of the herd, cries of anguish or cries that signify a gathering. The average frequency of cattle vocal communication is 8,000 Hz, which is the maximal frequency they can detect: on these frequency even very weak sounds (10 dB) are heard by cattle (Phillips, 1993). Sound signals are produced and received primarily during sexual attraction, including mating and competition. They may also be important in adult–young interactions, in the coordination of movements of a group, in alarm and distress calls, and in intraspecific signaling during foraging behavior.

Visual signalling between animals can be an obvious component of communication (Lomas et al. 1998). Cattle can distinguish several geometric forms as well their orientation (Rehkämper et al, 2000). The quality of light that is often considered is colour, but other characteristics are important in visual communication. Alterations of brightness, pattern, and timing also provide versatility in signal composition. The visual channel suffers from the important limitation that all visual signals must be line of sight. Information transfer is therefore largely restricted to the daytime and to rather close-range situations. Visual communicatory signals play a particularly important role among cattle's in open terrain. The fact that chemical signals comprise molecules means that, unlike acoustical or visual signals, chemical signals have a time lag. Olfactory communication between cattle is made and recognised essentially via pheromones (Signoret et al, 1997). These are chemical signals that are produced by an animal and are exuded to influence the behaviour of other members of the

- Binocular vision
- Clear vision up to the shoulder
- Reduced vision behind the shoulder
- Blind spot behind the animal



same species that engender a specific response in the animal that detects (perceives) them (Cheal, 1975). These are often of low molecular weight (<10,000). Usually produced by the female to attract males which may be volatile or non-volatile; water-soluble or fat-soluble, Proteins, polypeptides, and amino acids. Each species has a characteristic compound that may differ from that of other species by as little as a few atoms and typically synthesized directly by the animal and are usually derived from fatty acids. Cattle perception of odour is, therefore, more acute than human perception (Albright and Arave, 1997). Chemical signals have to be of an appropriate concentration if they are to be effective. A chemical normally considered to be an attractant can serve as a repellent if it is too strong. These molecules, present in all animal secretions are of a varied chemical nature but are mainly composed of aromatic alkenes (Phillips, 1993). Chemical signals may persist for a while, and time must pass before the concentration drops below the threshold level for reception by a searching animal. Since molecules of different sizes and shapes have varying degrees of persistence in the environment, the chemical channel is often involved in territorial marking, odour trail formation, and mate attraction. This channel is particularly suitable where acoustical or visual signals might betray the location of a signaller to a potential predator. The Jacobson organ appears more sensitive to pheromones than the mucous membrane of the nose. Thus, the presence of a stressed cattle or the odour of its urine will modify the behavioural reactions of its fellow creatures. (Boissy et al, 1998). One can also observe a slower learning capacity in heifers when they are

exposed to the odour of a stressed fellow animal. Thus, pheromones constitute a warning signal from the animal in danger to its fellows. Olfactory communication is more than often associated with one or several other modes of communication (postures or calls).

Tactile communicatory signals, such as the mutual grooming of females and subordinate individuals usually groom the dominant individuals (mainly adult males). Tactile sensitivity is the result of several types of sensory receptors that engender tactile perception (mechanoreceptors), thermal perception (thermo-receptors), and also perception of pain (noci-receptors). Tactile perception occurs via the mechanic deformation of the skin under the effect of contact and through the hairs. Thermal perception is conditioned by the temperature of the animal and the thermal conductivity of the object with which it comes into contact (a metal object seems colder than a wooden object because it transmits its temperature better to the skin). Finally, the perception of pain refers to a superior intensity than the aforementioned perceptions and their simultaneous stimulation. Direct contact between cattle occurs during mating, calving and the attention the calf receives after its birth, and during social grooming behaviour (Albright and Arave, 1997). Tactile contact qualified as 'negative' as well as 'positive': In literature, this is described as disagreeable, stressful or painful for the animals (for example beating, pushing or giving them an electric charge) (Boivin et al, 2003) whereas agreeable, gentle or soothing for the cows (such as rewarding the animal with food, flattering and stroking the animal) respectively. This positive contact with the animals helps to decrease their fear of humans.

SENDERS AND RECEIVERS

An animal that provides a signal is called a sender. The animal to which the signal is directed is the receiver. The receiver uses the signal information to help make a decision. For example, if a receiver must choose either to fight with or to flee from an opponent, it brings to this decision biases and thresholds passed on to it by successful prior generations. Prior experience in the receiver's own life may also play a role in shaping its evaluation of the situation. If it has routinely lost fights to larger animals, a useful strategy would be to assess the size of the opponent. This may be done by using vision or other means. For example, in some cases an opponent broadcasts a low-frequency sound signal at the receiver. Because only large

animals can produce low-frequency sounds, this signal provides evidence that the opponent is large. The receiver integrates its perception of the sound frequency with its prior experience and inherited avoidance of harmful situations and thus decides to flee.

SIGNAL PRODUCTION

The challenge faced by a sender is the creation of a controlled perturbation of the environment that can be detected and recognized by a receiver. The wavelength of a sound depends upon its frequency and the speed of sound in the propagating medium. For this reason, small animals tend to communicate with high-frequency sounds, and only large animals use low-frequency sound signals. The challenge for a sender is to produce a visible image that is detectable against the background by a receiver. One way to do this is to move the signal body part in front of a static background or to move it in a different direction relative to a moving background. The sender may also select a site in which to produce the signal that has a simpler background or that is moving in a very different way. Sender deposit or release chemicals called pheromones that receivers later detect by smell or taste. The cost to senders of chemical communication can be minimal, as when faeces or urine is used as a signal, or can be substantial, as when complex organic molecules must be synthesized solely for the purpose. The potential for signal diversity is extremely high in chemical communication, as is the opportunity to create a signal that is very different from background odours

Tactile signals involve special patterns of touching; touching during aggressive encounters may provide information about the body size and strength of opponents. All animal signals degrade as they propagate between sender and receiver. The farther apart the two parties, the greater this degradation will be and the less a signal will stand out from background noise. Senders can do little to reduce degradation once the signals have left the sender. Sound signals transmit efficiently over large distances, around obstacles such as trees and foliage, and in dark environments.

Olfactory signalling differs from sound and light communication in significant ways. Pheromones spread from a source by diffusion and medium turbulence. This process is much slower than the propagation of light or sound signals, and its erratic path can make it difficult for a receiver to locate an odorant source. The slow speed, the limited ability to be located, and the loss of temporal pattern constrain the uses of olfactory

communication to short-range signals and to recurrent functions, such as territory defence and mate attraction.

SIGNAL RECEPTION

The receiver's task is to detect signals against the background and to discriminate between different signals. Most animals use the same sense organs (eyes, ears, noses, touch receptors, etc.) for signals that they use to detect other external stimuli. Terrestrial animals often have funnel-shaped structures outside the body to collect and concentrate impinging sounds. The funnel shape also creates a gradual change in the properties of the sound-propagating medium from that of air to that of liquid and solid bodies. This increases the amount of trapped sound energy. At the end of the funnel is a thin membrane (called an eardrum) that is set into vibration by the sounds. Small bones or fibres transfer the eardrum movements to a fluid-filled cavity, within which are sensory cells bearing hair like cilia. The relative positions of receptor cells in an eye are preserved in their projections to the brain. This allows the brain to create a map that replicates, to varying degrees, the visual field of the eye. Projections from the visual maps of the two eyes are compared to identify specific objects and their relative distances. The recognition of patterns is a function of the brain and relies on a combination of inherited and learned mechanisms.

Pheromone reception is accomplished by smell (olfactory) or taste (gustatory) organs. These receptors contain sensory cells with fine cilia, or microvilli that extend into the medium. Pheromone molecules and other stimuli temporarily bind to specific proteins on the cilia or microvilli. The binding triggers a cascade of chemical reactions within the sensory cell that result in the production of nerve impulses flowing to the brain. The vomeronasal organ (Jacobson's organ), located in the roof of the mouth, is used to mediate a behavioural response known as flehmen, in which an animal raises its head and lifts its upper lip in reaction to specific odours. This response requires special movements of the tongue and lips to admit chemical samples to the sensory cells. The vomeronasal organ is the primary receptor organ for many of the pheromones that dictate interactions in mammalian social life, including pheromones involved in conflict, reproduction, and parental care.

COSTS AND BENEFITS OF COMMUNICATION

For both senders and receivers there are costs associated with engaging in

communication. It takes time, energy, and special modifications of sender and receiver organs to communicate. Thus, there must be compensatory benefits to each party for communication to be favoured by evolution. A sender will provide information to a receiver only if the decision of the receiver improves the sender's fitness more than the costs of signaling reduces it. The benefits to the sender may be direct, such as securing a mate or successfully repelling an opponent, or indirect, in that the receiver's choice may benefit close kin of the sender. A receiver attends to any source of information that is sufficiently reliable, on average, to enhance the receiver's decision making.

HONESTY AND DECEIT

The problem of signal honesty is an important issue in studies of animal communication systems. In the early days of ethology, signals were shown to evolve through the ritualization of behaviours that are, or were, functionally appropriate to the contexts in which the signals are given. Signals were believed to be honest indicators of underlying motivations because the signals were derived from physiologically or anatomically linked sources. Hence the dairy cattle is having immense importance to communicated with each other as it affects many biological function during production whose impact on feed intake it directly reduced the capability of individual to perform. Senders and receivers may have conflicting interests in the accurate exchange of information. Animal senders may also gain fitness by cheating under certain circumstances; the strength of the selective pressure to do so depends upon the signaling context and the degree to which the two parties have conflicts of interest. Conflict of interest is greatest when two more or less equal competitors both desire the same non-sharable resource. In the mate-attraction context, both male and female benefit from mating with the correct species and therefore agree about the accurate transmission of species information. But females may want to mate only with a high-quality male, which puts pressure on low-quality males to hide or exaggerate their quality. Therefore it is concluded that different ways of communication plays vital role to escape from the danger, in search of the mother for young one when they are apart from them and it is highly essential to be part of mating for both male and female via chemical signals comprise molecules.

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