

# MILK: STRATEGIES FOR FURTHER AUGMENTATION OF PRODUCTION AND CONSUMPTION

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Milk and milk products have remained a valued foodstuff for the predominantly vegetarian population of India. It is considered a part of a balanced human diet because of its high content of quality protein, calcium and vitamins particularly vitamin A, niacin, riboflavin and folic acid. In western diets, nearly 75 per cent of total calcium intake (1000-1500 mg) comes from milk and milk products. However, daily calcium intake in average Indian diets barely exceeds 500mg. A 250 ml serving of cow milk contains calcium that is equivalent to 60 per cent of Indian Council of Medical Research's (ICMR's) Recommended Dietary Allowance (RDA) for adults (400mg). An equal amount of buffalo milk contains 95 per cent of calcium RDA for adults. Besides these, milk also contains several bioprotective molecules that ensure good health. Conjugated linoleic acid (CLA), which is known to have anticarcinogenic and antiatherogenic activity in addition to being effective in immuno modulation, is naturally present in milk and milk products. Milk also has immunoglobulins, lactoferrin, lysozymes, lactoperoxidase and vitamin B12-binding protein, which have antimicrobial effect. In view of the importance of milk on nutritional well-being and public health, there is an urgent need for augmenting milk production and consumption through appropriate technological interventions.

## **Milk Production**

Dairying plays a vital role in providing not only nutritional security but also income and employment to a large segment of Indian population. It is estimated that nearly 20 million people are employed in the livestock sector in principal (11 million) or subsidiary (9 million) capacity. The distribution of livestock asset value is more equitable than land. While marginal and small landholders (<2.0 ha) own 63 per cent of the arable land, they own nearly 67 per cent of the bovines. The sector is also very gender sensitive as over 90 per cent of

the activities related to care and management of dairy animals are carried out by the women. The contribution of the livestock sector to the total national gross domestic product (GDP) is around 5.5 percent.

Dairying in India has shown remarkable progress in recent years. India registered a total milk production of 86.96 million tonnes in the year 2003, which is far above the USA(77.25 MT). On a global basis, India, with almost 16.9 per cent of world's human population, contributed nearly 14.7 per cent of the world's milk production of 592 million tonnes in 2003. In 1970 India's share in global milk production was only 9 per cent<sup>1</sup>. This growth has been achieved by following a multi-pronged strategy and the extensive intervention of Government agencies coupled with an increased demand, driven by population growth, rising income levels and rapid urbanization. With crop production reaching a plateau in terms of production and productivity, there is a need to adopt commercially viable diversification such as dairying. Some of the issues, which are important for sustainable growth in milk production in the country, are discussed in this manuscript.

## **Genetic Improvement for Quality Animals**

A cross breeding programme was envisaged in the mid sixties for improving the performance of indigenous breeds. While the programme, theoretically, offered attractive ways to enhance available genetic material in the country but there were major problems in implementation. Eventually, the good quality bulls needed for natural mating in breeding tracts became scarce, leading to a further deterioration of indigenous breeds in these tracts. There is, thus, an urgent need to produce quality indigenous bulls to provide the best male germplasm for breed improvement. The indiscriminate cross breeding spread all over

the country has led to extinction of many known breeds and spread of sexually transmitted diseases like Infectious Bovine Rhinotracheitis (IBR) at an alarming rate<sup>2</sup>. To overcome these problems, it is essential to ensure close co-ordination between different agencies involved in dairy development. Certain areas that need urgent intervention include:

- Development of an extensive infrastructure support system for preservation and supply of frozen semen through Government and private sector participation.
- Encourage participation of private sector and NGOs in the delivery of artificial insemination services at the farmers doorstep
- Improving natural breeding services for buffaloes
- Testing and monitoring the health of bulls and screening for communicable reproductive disease
- Strict quality control of semen supply and institutional restructuring for supply of quality semen to a specialized, autonomous and professional state-implementing agency
- Selection and training of NGOs and extension workers who could then train others in modern techniques for rearing dairy animals
- Improving the indigenous breeds possessing desirable characteristics, like disease resistance, heat tolerance and efficient utilization of low quality feeds.

### **Animal Health Issues**

In the last four decades efforts were made to control communicable diseases (Rinderpest, Foot and Mouth Disease, Hemorrhagic Septicemia, Black Quarter and Anthrax). Effective implementation of a vaccination programme has eradicated Rinderpest. Other diseases have not been controlled because of poor vaccination coverage; in spite of the fact that effective vaccines are available. Several newer diseases Blue Tongue, Contagious Bovine Pleuro Pneumonia (CBPP), Mucosal diseases are emerging as major problems.

Foot and Mouth Disease (FMD) is of considerable economic importance. It not only reduces milk yield but also limits the export potential of livestock products. Although massive vaccination programmes have been undertaken in the past, it has not yielded the desired results mainly because FMD protection is based on herd immunity. Effective vaccination requires that over 85 per cent of the animals in the area be vaccinated to establish herd immunity. Currently, only about 5 per cent of animals at risk are vaccinated. However, ring vaccination programme initiated in a few selected districts may help in creation of disease free zones.

Further strategies for ensuring animal health would, therefore, require concerted efforts in the following directions:

- Physical surveillance through villages, stock routes and institutional searches to detect hidden cases of Rinderpest to provide a safeguard against re-emergence of the disease.
- Expanding the scope of the programme on creating disease-free zone by covering other areas in the country (currently only Andhra Pradesh, Maharashtra, Gujarat, Punjab, Haryana, Delhi and Western Uttar Pradesh are covered).
- Creation and effective implementation of disease surveillance mechanisms using IT tools.
- Upgrading facilities for animal disease diagnosis and accreditation as per international standards.
- Proper animal quarantine, certification and enforcement with major emphasis on control of trans-boundary animal disease.
- Implementation of Livestock Health Schemes for dairy animals.
- Encouraging participation of private veterinary practitioners to deliver animal health services at farmers' door.
- Education and training of farmers to use scientific principles in the management of animals including cleanliness, hygiene and prophylactic measures.

## Issues Related to Feed and Fodder

The Bovine population in the country has been increasing at the rate of more than 1 per cent annually, which has offset the attempts to generate newer feed from non-conventional resources and agro-industrial by-products to meet the increasing demand. The permanent pastures and grasslands in our country is only 3.6 per cent of the total geographical area; the cultivable land for fodder production has remained static at around 4.8 per cent. The population growth rate (1.94 %) is a limiting factor for expanding the cultivation land for fodder production. Augmentation of feed and fodder resources must, therefore, focus on two issues. One, the centuries old crop-livestock integrated, mixed farming system which is under enormous stress has to be strengthened through better utilization of crop residues and secondly, the intensive dairy farming system has to adopt green fodder in a more scientific way. The working group on animal husbandry and dairying for Tenth Five Year plan has noted that the available fodder can meet the demand of only 46.7 per cent of the livestock. It is, therefore, essential that a multi-pronged strategy be adopted to bridge the gap:

- Judicious utilization of available agro-by-products like oil meals and cereal by-products by better management so that residues are collected, compressed, nutritionally enhanced, stored and distributed.
- Establishment of efficiency of utilizing non-conventional feed resources like mango seed kernel, mahowa cake and neem cake. and the development of specifications for utilizing these ingredients.
- Promote the adoption of feeding technologies developed to increase nutrient supply to animals by manipulation of the animal's digestive track through active as well as passive means.
- Encourage farmers to use new feed technologies like by-pass protein technology, total mixed ration, complete feed block technology and mineral mixture. to augment milk production and, thus, reduce the cost of production.

- Serious efforts should be made to use modern biotechnological tools to modify organisms capable of degrading ligno-cellulose feeds at high rate.
- Farmers need to be educated and provided with incentives to increase area under fodder cultivation by utilizing wasteland in and around villages.
- Promote the cultivation of high yielding varieties of green fodder, particularly, those which the permit multicutts.
- Encouraging participation of progressive farmers, NGOs and institutions in training local farmers for producing good quality fodder or utilizing available feed resources and enriching low quality fodder by scientific methods.
- Planned cultivation of suitable fodder trees and shrubs on village bunds as an integral part of agro-forestry programme.
- Creation of facilities for storage and preservation of food grains or agro-by-products to minimize damage and wastage.
- Enforce adherence to quality control measures for animal feeds and the establishment and strengthening of feed analytical laboratories in strategic locations in the country.

## Intensive Dairy Production Systems

The traditional crop-livestock integrated farming system, provides means of livelihood to landless and marginal farmers, and continues to dominate the dairy economy in India. It is based on low input and crop residue use. The system, however, has an inherent disadvantage, as the focus of farmers' attention is crop production with dairying remaining as a subsidiary activity. In the context of the present liberalized economy and global trade opportunities, quality of milk, particularly in terms of sanitary and phytosanitary measures, is of paramount importance. The traditional milk production system, which is very scattered, lacks the infrastructural support and mechanism to ensure quality. A feasible alternative could be the semi-intensive or intensive dairy production system, which could be adopted as a commercial venture. This would require the

development and dissemination of a package of scientific practices to maximize animal productivity/output per unit.

### **Institutional Lending System in Livestock Sector**

Public sector banks have only recently shown interest in providing credit support to the farmers. However, the organized financial sector is still inhibitive in financing livestock programmes. As a result, most livestock farmers end up taking loans from private agencies at high interest rates. Government intervention is, therefore, essential to ensure that financial institutions such as NABARD reserve a sizeable proportion of their lending to meet the short and long-term capital requirements of the animal husbandry and dairying sector. Venture capital funds need to be created to support private sector participation in the creation of infrastructure for both milk production and processing activities. Credit cards for dairy farmers on the lines of the Kisan Credit Card could be another alternative to provide financial support to the farmers for various dairying activities.

### **Milk Consumption Trends**

India has a per capita milk availability of 219 g, far below the world average of 285g per day, but meets the recommended nutritional requirement of milk by ICMR (220 g/person/day). However, the actual (economic) demand in near future would outstrip this supply. Thus, if the supply is not increased to match the demand, the excess demand would result in an increase in the milk prices, thereby, affecting the consumption and nutritional security of lower income groups. To meet the projected demand of 254 million tonnes by 2020, the milk production should, therefore, increase at 5.73 per cent per annum<sup>1</sup>. The demand for milk and dairy products is income elastic and growth in per capita income is expected to increase demand for milk and milk products. Studies in the past have indicated that the proportion of income spent on milk and milk products increased from 11.7 per cent in rural areas and 14.7 per cent in urban areas in 1970-71 to 21.6 and 16.7 per cent in 1999-00, respectively<sup>3</sup>. This

shows that demand in rural areas has increased more than in the urban.

A commodity-wise break up shows that 56 per cent of the milk produced in India is available as a marketable surplus for urban areas but a fairly large proportion of it is converted into milk products, mainly khoa, paneer, butter, ghee and traditional sweets. The share of the organized sector is very small (approximately 16 %). While the Government/co-operative sector markets nearly 80 per cent of the milk as liquid milk, the private sector markets only 30 per cent as liquid milk and the remaining 70 per cent as milk products, mostly comprising of powder, butter and ghee. The future for commodities like powder and ghee does not appear to be sustainable. Hence, a major shift in product mix for organized dairy industry is needed. Empirical evidence also suggests that the composition of an average Indian's food basket is gradually shifting towards value added products. It is, therefore, essential for the Indian Dairy Industries to initiate the manufacture of mass-market products for domestic as well as export markets<sup>4</sup>. The following issues are, therefore, immensely important.

### **Improvement in Quality of Milk and Milk Products**

The Indian Dairy Industry will be able to amass possible benefits by being a global contender in trade only after its products are at par with the rest of the world in terms of price and quality. The price competitiveness of Indian dairy products is often a direct offshoot of their quality, as price reduction is generally considered an indication of poor quality. Often, this results in unpredictable situations of trade in India. When international prices are low, the Indian market is threatened with imported goods. On the other hand, quality problems prevent an increase in exports even when global prices are high.

So, to maintain a strategic advantage, it becomes imperative that stringent quality measures are followed in all areas of the post-harvest handling of food products. A positive attitude towards the implementation of good hygiene practices at the primary milk production level and translating these as good

manufacturing practices (GMP) at the plant level should be the first steps taken. There is a need to promote clean milk production, prompt chilling and minimize/eliminate various pollutants and contaminants like pesticide residues, antibiotic drug, hormone, heavy metals and adulterants during processing and transportation. To ensure microbiological safety of milk and milk products, there is a need to develop cost effective, reliable and simple kits based on immunomagnetic separation (IMS) and for PCR based assays for rapid detection of these pathogens at the field level.

### ***Environment Friendly Processing Technologies for Enhanced Efficiencies***

Newer technologies such as UHT processing and Membrane processing are now available, which can be used to increase processing efficiently and reduce environmental impact. UHT processing is suitable for extending the shelf life of liquid milk as well as products like milk concentrate, cream, desserts and kheer. Currently available membrane processes like microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and Reverse Osmosis (RO) could be effectively employed for fractionating valuable components to develop newer intermediate dairy products, which can be incorporated in various functional food formulations.

### ***Dairy Ingredients in Non-Dairy Food Applications***

Several milk products have nutritional and therapeutic properties. Whey proteins are ingredients of speciality food products for paediatric and geriatric age group. Milk proteins are endowed with unique nutritional and functional characteristics that make them ideal ingredients in different food formulations. Hence, it is used in the manufacture of bakery products, comminuted meat products, beverage and confectionary products<sup>5</sup>.

While the demand for dairy products for value addition will continue to grow, the dairy market of the future will have new challenges. While a section of consumers, particularly domestic, will demand low priced products others would be

willing to pay a premium for quality and uniqueness. The challenge for the dairy industry would be to identify the segmented consumption pattern and develop tailored products.

### ***Shelf Stable and Convenience Foods***

Convenience, ready-to-reconstitute and ready-to-eat foods are gaining popularity at a pace never seen before. Though, the market for such foods is still limited to urban consumers, defence personnel, tourists and caterers; future growth of processed dairy food market will be driven to a significant extent by such products. Preservation processes employed for such products are either sterilization or dehydration. The severity of heat treatment as employed in sterilization result in severe damage to the nutritional, rheological and sensory properties. There is, thus, a need for developing processes, which can result in milder heat treatment, coupled with optimization of other preservation factors to achieve longer shelf life. Development of such technologies particularly for indigenous dairy products will open new vistas for value addition and export.

### ***Application of New Packaging Options***

High moisture content makes dairy products prone to microbial and chemical spoilage. Many packaging materials have been developed to address these problems. However, recent innovations in modified atmosphere packaging and active packaging further enhance the product quality. In modified atmospheric packaging (MAP), the gaseous composition of atmosphere is altered to retard the various reactions leading to deterioration of milk / dairy products. Active packaging (AP) is a group of technologies in which the packaging material performs some desirable role other than providing an inert barrier between the product and the out side environment. Such packaging options, if applied to processed foods, will greatly improve their shelf-life and increase their acceptability.

### ***Indian Dairy Products***

Indian dairy products play a significant role in the socio-economic and religious activities of our population. It is estimated that about 50 to

55 per cent of total milk produced (approx. 42 million tonnes) is converted into a variety of Indian dairy products by the unorganized sector (halwais) employing various unit operations like heat and acid coagulation, heat desiccation and fermentation. The market for these products is valued at about Rs 250 billion, which speaks volumes about the tremendous potential of the sector.

There is an increasing demand for Indian dairy products both among the large domestic and global consumer base. The changing global scenario in the post WTO era offers us an opportunity to become a global player in ethnic food markets. Process mechanization, sanitary and phytosanitary measures are, therefore, necessary to ensure that the indigenous milk products meet international quality standards.

### ***Value Addition with Buffalo Milk***

Buffalo milk constitutes nearly 55% of the total milk production in India. It is rich in fat, minerals like calcium (Ca) and phosphorus (P) and tocopherol, has higher content of lactoferrin, less content of urea and higher ratio of Ca and P. The inherent nutritional and physico-chemical properties of buffalo milk is an added advantage for Indian consumers. Buffalo milk is usually preferred over cow milk for khoa making, since the former gives greater yield and has a more desirable flavour, body and texture. Hence, the competitive advantages of buffalo milk need to be fully exploited for value addition and development of new products with special attributes.

### ***Functional Ethnic Foods***

With the evolution of novel technologies and scientific developments in the past years, an increasing number of potential nutritional products with medical and health benefits, so called “functional foods” have gained an important place in the world market. Functional foods are expected to perform particular functions such as the enhancement of the biological defense mechanisms, prevention/recovery from a specific disease, control of physical and mental conditions and slowing the aging process. Foods can be modified with the addition of phytochemicals, bioactive peptides,

omega-3 PUFA and probiotics and/or prebiotics to become functional. The potential for producing healthy functional foods incorporating valuable dairy and non-dairy ingredients in existing and new product formulations need to be exploited.

### **Research Support on Upgradation of Food Laws**

New developments in processing technologies will require changes in the existing regulations as feed back from the control systems to identify and manage both existing and emerging risks. Research efforts are, therefore, needed to generate an accurate scientific data on new dairy processing technologies, food packaging, methods for assessing contamination and chemical exposures. Emerging opportunities for the export of our dairy products, particularly indigenous milk products, require that database on presence and levels of pesticides, biocides and chemicals are created and upgraded periodically.

### **Biotechnological Applications in Food Processing**

Biotechnology has been exploited for centuries in animal and plant strain selection for food production, use of starter cultures to develop fermented dairy products and use of yeast strains in the production of alcoholic beverages. Biotechnology encompasses a wide range of technologies such as genetic manipulation, fermentation technologies, protein separation technologies and enzymes for food processing. Biotechnology can play an important role in development of tests for rapid detection of food pathogens and also in the development of a new range of functional foods with a potential to improve human health. Biotechnological approaches could greatly improve food quality through development of starter cultures and starter adjuncts for flavour improvement in fermented foods.

### **Conclusion**

Milk and milk products are not only a valued source of nutrition and provide income and employment to a large section of Indian population. Several years of strategic planning

and effective programme implementation by Government and public sector agencies have ensured that India emerges as a leading producer of milk in the world. However, the rising population and plateau in crop production trends necessitate that a renewed impetus is given to Indian dairying to meet projected demand. Some of the issues that need to be tackled on priority are: genetic improvement for quality animals, improvement of animal health, enhancement and enrichment of feed & fodder resources, establishment of commercial dairy farms and provision of institutional financial support. Furthermore, the post WTO scenario provides India with an opportunity to market its' products in other parts of the world, particularly to the over 150 million non-resident Indians. Tremendous export potential, therefore, exists for unique traditional milk products. The potential for producing functional foods incorporating valuable dairy ingredients in existing and new product formulations will also have to be exploited. Dairy scientists and entrepreneurs should adopt a holistic approach to product development encompassing new dimensions of value addition, newer processing know-how, to meet the international quality and safety standards.

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