CHAPTER 1
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CHAPTER - 1

DAIRY PRODUCTS INDUSTRY IN INDIA

In the 5th decade of the 20th Century three revolutions were started which were widely spread in India. These are the Red Revolution, the Green Revolution and the White Revolution.

The Red Revolution means revolution of Socialist and Communist nature. The Green revolution, denotes the efforts to raise the productivity of agricultural land. The subject matter of this study has no concern either with the Red Revolution or with the Green Revolution. This is solely concerned with the White Revolution. Which means revolution in the field of production and distribution of Milk in the country and as is explicit it is named after the colour of milk. Milk is the basic need for the child, mother and also for the old people and it is an ideal supplementary died for the young also, as it is considered to be a balanced and complete food. So much so that milk has become the symbol of health.

But its availability in India was still far from satisfactory. This is basically why, the country badly needed a revolution like this and it is yet even half way through it.

1.1 AIMS AND OBJECTIVES OF THE WHITE REVOLUTION (OPERATION FLOOD AND DAIRY DEVELOPMENT PROGRAMME)

"White Revolution" is movement for the floodisation of milk throughout the country alike in the city and the village.
Milk is the healthiest food for human being. Therefore, it must be provided to every body, and more to the children, old and the ill people.

"White Revolution" was named after the colour of the milk, which is white.

In fact the Operation Flood and Dairy Development Programme were the carriers of the White Revolution.

The Operation Flood Programme has got no official connection with the State Governments for funds and other workings. It has everything of its own to replicate the Anand Pattern all over the country. But the Dairy Development Programme is the Programme of State Governments, which is implemented by the State Government Officials. The District Dairy Development Officer is the Incharge of the Programme of his district.

Inspite of having same aims and objectives the work in different modes of operation. In fact both the Programmes are created and complementary to each other. Therefore, the basic need is of their co-ordination at every stage.

The Primary objective of Operation Flood is to replicate "The Anand Pattern" by:

(i) Organizing milk procurement at remunerative prices through economically viable Village Milk Co-operatives.

(ii) Efficient marketing of milk and dairy products produced in rural areas by:

(a) Building rural dairy plants to process all the milk offered by producers and to provide an adequate supply of milk to consumers at all times.

(b) Developing a basic transportation and storage network to facilitate regional and seasonal balancing of milk supply and demand.
(c) Increasing the capacities of the city milk plants and establishing new plants.

(iii) Increasing the share of Modern Operation Flood Dairies in the main Urban Milk Markets.

The main aim and objective of the District Dairy Development Office is to propagate the scientific and mythology of Dairy Development and providing subsidy and loan through banks for the purchasing of cows and buffaloes.

A. OPERATION FLOOD

Operation Flood (I) was started in 1970 with an investment of Rs.116 crores donated (in kind) by the European Economic countries "via" world food Programme.

The primary objective of the Project was to make available wholesome milk at stable and reasonable prices to the city consumers in the four metro cities of India.

Due to failure of the planning and its implementation the original five year project extended by further 6 years (total 11 years). But the four metro cities could not reach the point of self-sufficiency in the field of milk production.

Therefore, the Government started yet another massive seven year Project with an investment of Rs.483.67 crores. Out of which Rs.173 crores was to come as a World Bank loan.

The Second "Operation Flood" (II) Project was started in 1978, while the first Project was still incomplete and in operation with unutilized fund in Band.

The Second Project of Operation Flood also depended on the heavy give of imported milk products. This was ended in the year 1987-88. Further in 1988-
89 the foreign gift of milk products amounting to Rs.67.12 crores was imported.

Under Operation Flood II, a World Bank loan of US $150 million was received.

Operation Flood III started after the completion of operation Flood II in the year 1985.

In March 1988, a Technology Mission for Dairy Development was initiated.

Although under operation Flood II a sum of US $150 crores as the World Bank loan was already received, there was a Provision of US $360 million for on going phases of the Project. Thus since its start in 1970, these centrally run Projects have involved out-lay of Rs.2,000 crores.

The committee on Public Undertaking (COPU) in its 6th report, which was presented in the Lok Sabha on 30th March 1987, commented adversely on the Progress in regard to rearing a National Milk Herd.

The Committee (COPU) observed that as against the target of 140 lakhs cross-fred cows and upgraded buffaloes only 7.75 lakhs animals had been reared.

Secondly, the Project duration has increased from the original 7 years time to twelve years with an additional outlay of Rs.691.27 crores. The Committee questioned that why the targets of the National Milk Head could not be raised correspondingly.

Due to all these shortcomings, Shri A. T. Dudani (the former Additional Animal Husbandry Commissioner, Government of India) questioned the efficacy of the Operation Floods I, II and III sponsored by Foreign Funds. Shri Dudani observed that socially and economically backward, landless and small farmers do not get adequate returns from milk production, as returns do not meet the cost of production.
B. NATIONAL DAIRY DEVELOPMENT BOARD (NDDB) AND OPERATION FLOOD PROGRAMME (OFP):

The National Dairy Development Board (NDDB) was created in the year 1965. Its main objective was to transform the socio-economic conditions of the rural area through co-operative dairy programme of "Anand Pattern".

During the 4th Five Year Plan Chief Ministers were requested by the Prime Minister to implement the Anand Pattern and the Central Government created a body to replicate the Anand formula all over the country. The then General Manager of Amul, Dr. Verghesh Kurien was named as the Chairman of the body (Committee).

The "Kurien Committee" observed that many Chief Ministers and their staff had different opinions regarding the Anand Pattern, and thus their attitude was not conclusive to its proper implementation. Hence it was not appropriate to depend upon Government machinery for the success of the programme.

Therefore, the Committee observed that the programme had to get its own Project and fund to replicate Anand Pattern all over the country. And thus Operation Flood came into being in the year 1970.

In the year 1970 the Central Government accepted the Kurien Committee report and planned the way for the attachment of Operation Flood Programme with the World Flood Programme (WFP), the Food and Agricultural Organization (FAO) only to provide fund with the help of Western countries and with the several economic and monetary organizations of the world.

Between 1970-75, World Food Programme donated 1,26,000 tons of skimmed milk powder and 42,000 tons of butter oil to the Operation Flood Programme and in the same period Operation Flood programme earned Rs.954 million through the sale of donated milk product in the open market.
The Indian Dairy Corporation was also created by the Central Government, which was latter merged with the National Dairy Development Board under the N.D.D.B. Act of 1987.

C. NATIONAL MILK GRID:

By linking major cities and towns with their hinterland milksheds, the National Milk Grid would ensure the distribution of milk and milk products in a manner, which safeguards the interests of both poor rural producers and urban consumers.

The year 1999–2000 marked another year of growth for the dairy industry in the cooperative sector. Milk procurement by the Operation Flood dairies touched a new peak of 86.0 lakh lpd as compared to 62 lakh lpd in 1982–83. The year ended with a daily average procurement of 47.4 lakh litres of milk. At the end of March 2001, over 1000 rural dairies were marketing liquid milk in about 193 Class I towns and 212 smaller towns. By linking major cities and towns with their hinterland milksheds the National Milk Grid has assumed the responsibility for ensuring distribution of milk and milk products in a manner which safeguards the interests of both poor rural producers and urban consumers.

The total liquid milk processing capacity of the four metro dairies rose to 35 lakh lpd from 31 lakh lpd with the commissioning of Mahanand Dairy at Bombay. These dairies marketed about 27.5 lakh lpd of milk in the four major cities: Delhi, Bombay, Calcutta and Madras, registering a growth of about 6 per cent over the previous year. The fresh milk input of these dairies rose from 15.9 lakh lpd to 17.2 lakh lpd, a growth of almost 8 percent. The overall throughput of the metro dairies increased by 277 per cent, and the procurement has more than doubled. Out of 173 crore liters of milk procured by the feeder/balancing dairies in last decades, the largest portion was marketed as liquid milk; 29 per cent was directly sold in the milkshed area; 49
per cent was marketed in other areas including the four metro cities, and the remaining 22 per cent was converted into products.

The ghee market experienced an unprecedented upsurge in the face of the doubts about the quality of vanaspati. As a result, the liquid milk supply to the city dairies dropped considerably in the last quarter of the year and the prices of milk and milk products rose as well. This market situation was in total contrast to the previous year's experience when the ghee market had collapsed, thus underlining a need for market intervention with the help of a prudent buffer stock of dairy commodities. Whereas the Delhi dairies faced an uncertain fresh milk supply from the Northern Region federations because of the expanded market for the dairy products, the dairies in Bombay were flooded with surplus milk as a result of the price advantage offered to the Maharashtra farmers.

In both the above cases, the operations of the Grid led to the restoration of normalcy. In case of Delhi, the dairies were helped to maintain their market share by increased supply of SMP and white butter till normal fresh milk supply could be restored after price negotiations with the concerned federations leading to increased returns to farmers in the Northern Region.

Maharashtra was helped out of its surplus situation by routing milk supplies from Maharashtra to the milk-deficit city of Calcutta. Negotiations are under way for supply of milk from Maharashtra to Jamshedpur in Bihar and Raipur in Madhya Pradesh.

Recognising the need to increase the fresh milk input of the Calcutta city dairies, the Government of West Bengal increased the procurement price of these dairies. This decision would help the cooperative dairies to compete effectively with the private traders who route their milk mainly towards sweet-meat production.
The Grid has also been instrumental in increasing the efficiency of transactions by breaking geopolitical barriers such as movement of milk between Gulbarga, Hyderabad and Chittoor—Bangalore to reduce transportation and administrative costs. Attempts are also being made to reduce transportation cost by transporting condensed milk rather than fresh liquid milk.

Towards building a buffer stock of dairy commodities, about 15,000 tonnes of SMP and 3,400 tonnes of white butter have been procured indigenously. This operation has also alleviated, to a large extent, the working capital problems of a large number of dairies.

The above operation of transportation and buffer stocking are being supported by maintenance of a fleet of 81 rail tankers (capacity 28.6 lakh litres) and 596 road tankers (capacity 67.78 lakh litres).

Orders have been further placed for 32 rail tankers (capacity 11.66 lakh litres) and 217 road tankers (capacity 21.55 lakh litres). Under the NMG, storage facilities for skim milk powder, butter oil and white butter have been created in the metro cities. Storage space for maintaining 8,300 tonnes of SMP and 1,200 tonnes of white butter/butter oil were available at the end of the year. Additional storage capacity for 3,000 tonnes of SMP and 1,000 tonnes of white butter is under construction.

The National Cooperative Dairy Federation of India (NCDFI) has already been restructured, and the apex cooperatives at the State—level can now become its members. The NCDFI would ultimately become the apex body of all the dairy federations in the country, which can be entrusted, with the management of the National Milk Grid activities. To facilitate operations of the Grid, four Regional Programming Committees have been established by the NCDFI, which will meet periodically in respective regions. These committees will provide a platform for the participating federations to transact business and share each other's experience in the management of milk procurement,
handling and marketing. The activities of the four programming committees will be coordinated by a Central Programming Committee. The NCDFI can thus provide the basic institutional framework for better coordination, monitoring and guidance giving adequate direction to the State federations to ensure a stronger cooperative milk marketing system in the country.

1.2 BEGINNING OF A REVOLUTION

The revolution started as awareness among the farmers that grew and matured into a protest movement and the determination to liberate them. Over four decades ago, the life of a farmer in Kaira District was very much like that of his counterpart anywhere else in India. His income was derived almost entirely from seasonal crops. The income from milch buffaloes was undependable. The marketing and distribution system for the milk was controlled by private traders and middlemen. As milk is perishable, farmers were compelled to sell it for whatever they were offered. Often, they had to sell cream and ghee at throwaway prices. In this situation, the one who gained was the private trader. Gradually, the realization dawned on the farmers that the exploitation by the trader could be checked only if marketed their milk themselves. In order to do that they needed to form some sort of an organization. This realization is what led to the establishment of the Kaira District Cooperative Milk Producers' Union Limited (popularly known as Amul) which was formally registered on December 14, 1946.

The Kaira Union began pasteurizing milk for the Bombay Milk Scheme in June 1948. An assured market proved a great incentive to the milk producers of the district. By the end of 1948, more than 400 farmers joined in more village societies, and the quantity of milk handled by one Union increased from 250 to 5,000 liters a day.

A. HISTORY OF CO-OPERATION DAIRY IN INDIA

The history of Co-operative in India starts from 1946, when the British Government awarded to a private farm the monopoly right to procure milk in
Kaira district in the then Bombay Province and to supply the milk to the Government for distribution in Bombay city. That farm delegated this duty to contractors who were reliable. The Contractors appointed for the foresaid task constituted a Co-operative Society of their own.

After a long fight the cooperatives were authorized to collect milk from the area and supply that to the Government.

The Kaira district Co-operative Milk Producers Union was the Central body of the Village Milk Producers' Co-operative Society of the Kaira District.

The National Dairy Development Board was created by the Central Government in 1965 to transform the socio-economic condition of the rural area of the country through Co-operative dairy programme of Anand Pattern in the 4th five-year plan.

For that very purpose the Central Government had appointed a Committee under the Chairmanship of the then General Manager of the Kaira district, Co-operative Milk Producers' Union, Dr. Verghese Kurien.

As explained earlier in this study the Committee found that many Chief Ministers and their staff were against the provision of ownership by the milk producers through the village Dairy Co-operatives, the District Milk Union and other such organizations.

Therefore, the Kurien Committee mentioned in its report to the Central Government that the Dairy Programme of National Dairy Development Board and the Central Government has to get its own project and funds to replicate the Anand Pattern.

In this way the Operation Flood Programme came into being in the year 1970. The Programme has got no official connection with the State Governments for fund and working. It has everything of its own to replicate the Anand Pattern.
all over the country through village Milk Producers Co-operative Societies through which it emulated the principle of democratic decentralization.

Their members control the Village Milk Co-operatives. The Village Co-operatives federates into a district milk union of its own and the district milk union is federated into a State Dairy Federation.

1.3 DAIRYING IN INDIA 2000 A.D.

In past few decade dairying has developed leaps and bounds in India. The infrastructure laid in 1980's started bearing at the turn of the century. This facility with technology development in India has produced remarkable results in dairying in India. The pace of dairy development in the past few decade is any indication, India is on the brink of a many technological changes and nothing can be said about where the country's dairy industry will be at the turn of the century. It is, however, certain that the infrastructure laid down so painstakingly all across the country in the recent past will begin to bear the fruit. This coupled with the high technology that is knocking at our doors here as it is elsewhere in the world will change the face of the industry as we know it today. It becomes an interesting exercise and a useful one to extrapolate the evolving patterns and predict what the future might hold for us.

Our efforts, therefore, will be directed towards achieving this objective by looking after our dairy animals better and by putting to practical use certain scientific and technological innovations in feeding, breeding and disease control of the milch stock. Dairying shall continue to be subsidiary or side occupation for most farmers and a major source of income for the landless people whose numbers are likely to increase. The number of dairy animals kept by an average farmer will probably continue to be one or two buffalos or cows. The pattern of dairy development structure on cooperative lines has permeated across the land and will begin to take roots in most of the regions in the country.
A. CROP RESIDUE BASED MILK PRODUCTION:

The competition between man and animal for the limited available land will dictate ever-increasing use of crop residues for cows and buffaloes. While a small, limited area may be committed to the production of high yield fodder, utilization of crop residues such as wheat or rice straw, stalks and stovers of Jowar, Maze and Bajra etc. shall constitute the backbone of the feeding material for dairy animals. As a matter of fact cultivation of more cereal crops may have to be considered in order to produce larger quantities of straw.

Straw treatment which converts the tough lingo cellulose complexes of these low grade roughages to more digestible forms will be come popular. So, also will the urea molasses block or lick. Its widespread use has not been possible until recently for want of a practical method of manufacturing and distributing it to dairy farmers in villages. The urea molasses block has the double edged advantage of stimulating rumen activity resulting in increased uptake of straw as also of sparing useful proteins that bypass degradation in rumen and become available for animal nutrition and subsequent conversion into milk. This results in saving a substantial portion of the concentrate component of the feed and accounts for savings of upto 30 per cent in the overall cost of feeding. Such innovation in feeding of dairy animals will reduce the cost of milk production and increase the profit of the dairy producer — the only guarantee that will keep him in this business.

B. SPEEDIER UPGRADING OF OUR DAIRY ANIMALS:

The past few decades saw widespread use of artificial insemination, which exploits the potential of good quality or proven bulls. The future years will witness, in addition to the technology of ova transplantation, which exploits the potential of high yielding cows and buffaloes. It is based on the principle of inducing prized cows/buffaloes to superovulate by administering fertility drugs, i.e. produce several ova (10–15) instead of the usual one ovum. These
are transformed into as many fertilized ova after the cow/buffalo is serviced or inseminated with the semen of a high quality bull. The fertilized ova are washed out of the reproductive tract for subsequent surgical or non-surgical transplantation into the utera of several ordinary cows. The fertilized ova may also be frozen for use at appropriate time later or transported to other places.

Thus, this technology permits rapid upgrading of the milk producing potential of the existing dairy herds. One does not have to wait for five years or longer to evaluate the performance of bulls/cows. Under Indian conditions it is desirable to transplant only female embryos for milk production. This requires sexing or determining the sex of fertilized ova within eight days of fertilization. This technique, though not available today, may be worked out in near future.

C. ANIMAL HEALTH CARE AND FIELD RECORDING PROGRAMMES:

The Foot–and–Mouth Disease wreck havoc every year in our country – an estimated Rs.630 crores are lost in milk production and lost animals. A newer and updated FMD vaccine is now available from the Indian Dairy Corporation’s newly established plant at Hyderabad. The technology of vaccine production will undergo changes and perhaps oral vaccine administered through the Urea Molasses Lick would become possible. This would enable us to control Foot and Mouth disease in India effectively.

To assist the dairy farmer further in his efforts towards better breeding, feeding and disease control, progeny testing programme and national recording programme would be put in place in the near future. As a prerequisite to such programmes, an animal identification system is being worked out. Computers will be used to record all data (date of birth, pedigree, body weight, date of servicing, vaccination etc together with rations given and daily production figures) on all India basis. Records of individual cows,
buffaloes and bulls thus generated would be utilized in adjusting feeding and breeding practices.

D. MILK PRODUCERS' COOPERATIVE SOCIETIES:

The number of primary milk producers' cooperative societies, the key component of the dairy development programme, has increased in last decades from the 28,000 to about 100,000, as nearly 5000 new societies are now being formed every year. These societies will involve greater participation of milk producers. Future developments may transform these cooperatives to be efficient business organisations, manned by professionals and freed from official and bureaucratic control by modification in the Cooperative Societies Act so that cooperatives truly become a people's organisation.

E. MILK COLLECTION AT THE VILLAGE SOCIETIES:

It is nearly certain that there will be less frequent milk collection from the villages than the present twice daily ritual. Innovations such as preservation of milk through lactoperoxidase system may help in that direction. Milk will be handled in bulk tanks at the society and transported by road tankers as the cans become gradually a thing of the past also will be the Gerber test for milk fat. A modern electronic instrument will take over the weighing and recording of milk, testing of fat and, SNP and computation of payment to the producer on the spot. This instrument will greatly simplify accounting activity as well. With the electronic gradually moving in our villages the farmer will be able to view many of the developmental programmes on TV.

F. DISTRICT UNION'S DAIRY:

The milk processing facility at the district level shall cater to and capture the market of its cities and towns. Every major city of the country will have an organised processing and distribution system. Under the National Milk Grid,
long distance transportation of milk, wherever necessary, will involve 'containerized' tankers, suitable for both rail and road. The dairies will have larger silos to store milk. Milk reception will utilize load cells and flow meters to receive milk transported by tankers. The dairies will get bigger and bigger.

Energy saving considerations will govern the design and choice of dairy plant equipment and operations. For example, a 98 percent regeneration of heat will have been achieved in the pasteurizers. In the face of mounting effluent treatment costs, waste of milk (drippings, careless handling) has been brought down drastically while the use of water (and other utilities) will be restricted to the minimum, necessary for the operation aided by computers. The effluent may also be recycled. Online testing (for fat etc) for product standardization and CIP would be common place in a dairy plant. All buttermilk and whey, including acid whey, shall have to be utilized in order to reduce the BOD and COD burden in the effluent.

The use of Co-generation principle using gas fired turbines to generate electricity while the exhaust from the same to generate steam for use in the dairy plant operations will become more extensive. Future years will also see increased use of biogas. The buildings housing the dairy plants shall be of simple structure taking advantage of the innovations in modular design and prefabricated construction. Many milk powder plant silos will be located out of the building.

Computers are assist not only in technical operations of the dairy plant, but also in much of its accounting activity. Online information about stocks of milk at different dairies has also become possible through a centralized system. This has allowed a dairy in need of milk to requisition supplies from another dairy in the same or different region of the country.
G. NEWER DAIRY PRODUCTS:

UHT or long life milk will catch on not only in the metro cities but in other large industrial centers (like the steel towns etc) as well. This will replace the backbreaking routine of daily pick up of milk for the consumer who will be able to stock 3–4 days’ milk. In the metro cities most of the liquid milk will be dispensed through bulk vending machines, tetra pack or pouches as glass bottles are relegated to the past. The use of low fat or toned milk will increase on account of the need to extend supplies and due to the awareness of reducing fat intake by the consumer.

There will be a large variety of dairy products in the market place. Indigenous products such as shrikhand, gulabjamun, rasogolla, peda etc. will find a place in the product mix of various dairies and shall contribute to the profitability of these enterprises. These products will have a better quality and better packaging than at present. Other dairy products that will find favour with the consumer are: flavoured yoghurt, ice cream, cheese and a 50:50 butter-margarine bread spread. The urban consumers would be more conscious of the quality of milk. Bacteriological quality standards may be instituted for many dairy products.

H. TOMORROW’S DAIRY PROFESSIONAL:

India’s future dairying will no doubt be high tech one and yet its very base will be the network of rural cooperatives spread across the land. The success of such enterprises will depend upon the efforts of their managers whose challenge will include efficient management of these dairy units at the village level in harmony with other socio—economic activities that are vital to rural welfare. This will require an all round rural manager conversant with modern management and dedicated to the rural cause. Officials of the Government will have declining role in dairy development except where the laws of the land are to be enforced particularly those concerning quality.
Keeping in view the application of advanced technology to the dairy industry, tomorrow's professionals would have to possess knowledge or appreciation of computers and a 'system approach' in addition to their skills in classical disciplines of dairy science, namely animal husbandry, dairy technology and engineering etc. Our teaching and research institutions shall have to be finely tuned to these realities of tomorrow.

I. INDIA: WORLD'S LARGEST MILK PRODUCER:

India has become the world's No. 1 milk producing country, with output in 1999-2000 (marketing year ending March 2000) forecasted at 78 million tonnes. United States, where the milk production is anticipated to grow only marginally at 71 million tonnes, occupied the top slot till 1997. In the year 1997, India's milk production was on par with the U.S. at 71 million tonnes. The world milk production in 1998 at 557 million tonnes would continue the steady progress in recent years (see Table 1). Furthermore, the annual rate of growth in milk production in India is between 5-6 per cent, against the world's at 1 per cent. The steep rise in the growth pattern has been attributed to a sustained expansion in domestic demand, although per capita consumption is modest - at 70 kg of milk equivalent.

J. ANNUAL MILK PRODUCTION HAS TREBLED:

India's annual milk production has more than trebled in the last 30 years, rising from 21 million tonnes in 1968 to an anticipated 80 million tonnes in 2001. This rapid growth and modernization is largely credited to the contribution of dairy cooperatives, under the Operation Flood (OF) Project, assisted by many multi-lateral agencies, including the European Union, the World Bank, FAO and WFP (World Food Program). In the Indian context of poverty and malnutrition, milk has a special role to play for its many nutritional advantages as well as providing supplementary income to some 70 million farmers in over 500,000 remote villages.
### TABLE 1.1

**WORLD'S TOP MILK PRODUCERS**

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### DAIRY INDUSTRY PROFILE

- **Human population**: 953 million
- **Dairy farmers**: 70 million
- **Milk production**: 74.3 million tonnes (203.5 million lpd)
- **Average annual growth rate (1995-2000)**: 5.6%
- **Per capita milk availability**: 214 g/day or 78 kg/year
- **Milch animals**: 57 million cows 39 million buffaloes
- **Milk yield per breedable bovine in-milk**: 1,250 kg
- **Cattle feed production (organized sector)**: 1.5 million tonnes
- **Turnover of veterinary pharmaceuticals**: Rs.550 crores
- **Dairy plants throughput**: 20 mlpd
- **Throughput as % of total milk output**: 10
- **Value of output of milk group (1994-95)**: Rs.50,051 crores
- **Value of output of dairy industry**: Rs.105,000 crores

* Based on producer's price. ** Based on retail price.
DAIRY PRODUCTS INDUSTRY IN INDIA - AN OVERVIEW

CHAPTER 1

GRAPH NO.: 1.3

MILK FLOW FROM PRODUCER TO CONSUMER, 1995

<table>
<thead>
<tr>
<th>DAIRY ANIMAL POPULATION (million)</th>
<th>CATTLE</th>
<th>BUFFALOES</th>
<th>OTHERS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>204</td>
<td>84</td>
<td></td>
<td>288</td>
</tr>
<tr>
<td>Milk Animals</td>
<td>5.7</td>
<td>39</td>
<td></td>
<td>46.3</td>
</tr>
<tr>
<td>In Milk</td>
<td>31</td>
<td>25</td>
<td></td>
<td>56.4</td>
</tr>
<tr>
<td>MILK OUTPUT (hundred thousand)</td>
<td>29.8</td>
<td>34.8</td>
<td>1.7</td>
<td>66.3</td>
</tr>
<tr>
<td>(45.0%)</td>
<td>(52.5%)</td>
<td></td>
<td>(2.5%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>PRODUCTION SECTOR</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy Producers (million)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk production (millions tonnes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Volume (million tonnes)</td>
<td>70</td>
<td>65.0</td>
<td>1.3</td>
<td>66.3</td>
</tr>
<tr>
<td>(95%)</td>
<td>(92%)</td>
<td></td>
<td>(2%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>RURAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RETENTION</td>
<td>23.4</td>
<td>65.0</td>
<td>1.3</td>
<td>66.3</td>
</tr>
<tr>
<td>(35.3%)</td>
<td>(92%)</td>
<td></td>
<td>(2%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>DISPOSAL</td>
<td>41.6</td>
<td>1.3</td>
<td>70</td>
<td>66.3</td>
</tr>
<tr>
<td>(62.7%)</td>
<td>(2%)</td>
<td></td>
<td>(100%)</td>
<td></td>
</tr>
</tbody>
</table>

For the full graph, refer to Dairy India 1997.

GRAPH NO.: 1.4

DAIRY MAP OF INDIA

- High (above 150g/day)
- Medium (150-100g/day)
- Low (Below 100g/day)
1.4 DEFINITION OF DAIRY PRODUCTS:
(UNDER THE PREVENTION OF THE FOOD ADULTERATION (PFA) RULES)

A. MILK:

The secretions derived from complete milking of healthy milch animals and shall be free from colostrums. Milk of different classes and of different designations should conform to the standards laid down under the PFA rules.

❖ Boiled: Milk brought to boil.

❖ Double toned: The product prepared by admixture of cow and buffalo milk or both with fresh skimmed milk, or by admixture of cow or buffalo milk or both with non-fat milk solids and water, or by partial abstraction/addition of fat from/to milk. It should be pasteurized and should show a negative Phosphatase Test. When fat or dry non-fat-milk solids are used, it shall be ensured that the product remains homogeneous and no deposition of solid takes place on standing.

❖ Flavoured: Contains nuts (whole, fragmented or ground), chocolate, coffee, or any other edible flavour, edible food colors and cane sugar. Flavoured milk should be pasteurized, sterilized or boiled.

❖ Mixed: Combination of milk of cow, buffalo, sheep, goat or any other milch animal and may be a combination of any of these milk, which has been made to conform to the standards.

❖ Pasteurized: Milk subjected to pasteurization. The process of heating every particle of milk or milk product at least 63°C and holding at such temperature continuously for at least 30 minutes, or heating it to at least 71.5°C and holding at such temperature continuously for at least 15 seconds or at an approved temperature-time combination that will serve to
give a negative Phosphatase Test. All pasteurized milk and milk products should be cooled immediately to a temperature of 10°C or less. Here the term milk products means standardized milk, recombined milk, toned milk, double toned milk, skimmed milk and flavoured milk.

- **Recombined:** The homogenized product prepared from milk fact, non-fat-milk solids and water. Recombined milk should be pasteurized and should show a negative Phosphatase Test.

- **Skimmed:** The product prepared from milk from which all the milk fat has been removed mechanically.

- **Standardized:** Milk of cow, buffalo, sheep or goat, or a combination of any of these milk that has been standardized to the prescribed fat percentage by the abstraction and/or addition of milk fat, or by the addition of skimmed milk or by addition of recombined or reconstituted skimmed milk. The standardized milk should be pasteurized and should show a negative Phosphatase Test.

- **Toned:** The product prepared by admixture of cow or buffalo milk or both with fresh skimmed milk or by admixture of cow or buffalo milk or both with non-fat-milk solids or milk powder and water; or by partial abstraction/addition of fat from/to milk. It shall be pasteurized and shall show a negative Phosphatase Test. When fat or dry non-fat-milk solids are used, it should remain homogeneous and no deposition of solids homogeneous and no deposition of solids take place on standing.

- **Sterilized:** Milk subjected to sterilization, the process of heating milk continuously to a temperature of 115°C for 15 minutes or 145°C for 3 seconds, or equivalent approved temperature-time combination to ensure preservation at room temperature for a period of not less than 15 days from the date of manufacture. Sterilized milk shall show that absence of
albumen by a negative Turbidity Test. Sterilized milk shall be sold only in the container in which the milk was sterilized.

B. MILK PRODUCTS:

Milk Products include the products obtained from milk such as cream, malai, curd, skimmed milk curd, chhana, skimmed milk chhana, cheese, processed cheese, ice cream, milk ices, condensed milk (sweetened and unsweetened), condensed skimmed milk (sweetened and unsweetened), infant milk food, milk powder, skimmed milk powder, partly skimmed milk powder, khoa, table butter and desi butter.

❖ Desi Butter (cooking): The product obtained from cow or buffalo milk or a combination thereof or from curd obtained from cow or buffalo milk or a combination thereof without the addition of any preservative including common salt, any added colouring matter or any added flavouring agent. It shall be free from other animal fats, wax and mineral oils, vegetable oils and fats. It shall contain not less than 76.0 percent of milk fat by weight.

Table (creamery): The product obtained from cow or buffalo milk or a combination thereof or from cream or curd obtained from cow or buffalo milk or a combination thereof with or without the addition of common salt and annatto or carotene as colouring matter. It shall be free from other animal fats, wax and mineral oils, vegetable oils and fats. No preservative except common salt and no colouring matter except annatto or carotene shall be added. It shall contain not less than 80% by weight of milk fats, less than 1.5% by weight of curd and less than 3.0% by weight of common salt. Diacetyl may be added as a flavouring agent but, if so used, the total diacetyl content shall not exceed 4 parts per million. Calcium hydroxide, sodium bicarbonate, sodium carbonate, sodium, polyphosphate, (as liner phosphate with a degree of polymerization up to 6 units) may be added for
regulating the hydrogen ion concentration in the finished products, not exceeding 0.2 percent by weight of butter as a whole.

**Hard Cheese:** The product obtained by draining after coagulation of milk with a harmless milk-coagulating agent under the influence of harmless bacterial cultures. It shall not contain any ingredients not found in milk, except coagulating agent, sodium chloride, calcium chloride (anhydrous salt) not exceeding 0.02 per cent by weight, annatto or carotene colour, and may contain emulsifiers and/or stabilizers, namely citric acid, sodium citrate or sodium, salts or orthophosphoric acid and polyphosphoric acid (as linear phosphate with a degree of polymerization up to 6 units), not exceeding 0.2 per cent by weight. Wax used for covering the outer surface shall not contain anything harmful to health. In case the wax is coloured, only permitted food colour shall be used. Hard cheese shall contain not more than 43.0 per cent moisture and not less than 42.0 per cent milk fat of the dry matter. It may contain 0.1 per cent of Sorbic acid or its sodium, potassium or calcium salts calculated at Sorbic acid; or 0.1 per cent of nicin singly or in combination.

**Processed:** The product obtained by heating cheese with permitted emulsifiers and/or stabilizers-citric acid, sodium citrate, sodium salts of orthophosphoric acid and polyphosphoric acid (as linear polyphosphate with a degree of polymerization up to 6 units) with or without added condiments, and acidifying agents-vinegar, lactic acid, acetic acid, citric acid, and phosphoric acid. Processed cheese may contain not more than 4.0 percent of anhydrous permitted emulsifiers and/or stabilizers, provided that the content of anhydrous inorganic agents shall in no case exceed 3 per cent of the finished product. It shall not contain more than 47% moisture. The milk fat content shall not be less than 40 percent of the dry matter. Processed cheese may contain 0.1 percent sorbic acid or its sodium,
potassium or calcium salts (calculated as sorbic acid) or 0.1 per cent of
nicin.

- **Chhena or paneer**: The product obtained from cow or buffalo milk or a
  combination thereof by precipitation with sour milk, lactic acid or citric
  acid. It shall not contain more than 70 percent moisture and the milk fat
  content shall not be less than 50 per cent of the dry matter.

**Skimmed milk**: The product obtained from cow or buffalo skimmed milk
by precipitation with sour milk, lactic acid or citric acid. It shall not contain
more than 70 per cent moisture. The milk fat content of the product shall
not exceed 13 per cent of the dry matter.

- **Condensed milk, sweetened**: The product obtained from cow buffalo milk
  of a combination thereof or from standardized milk, by the partial removal
  of water and after addition of cane sugar. It may contain added refined
  lactose, permitted flavour, calcium chloride, citric acid, sodium citrate,
  sodium, salts of orthophosphoric and polyphosphoric acid (as linear
  phosphate with a degree of polymerization up to 6 units) not exceeding
  0.3 percent by weight of the finished product. Such additions need not be
declared on the label. Condensed milk sweetened shall contain not less
than 9.0 per cent milk fat, not less than 31.0 per cent total milk solids and
not less than 40.0 per cent cane sugar.

**Milk, unsweetened (evaporated milk)**: The product obtained from cow or
buffalo milk or a combination thereof or from standardized milk, by the
partial removal or water. It may contain added calcium chloride, citric acid
and sodium citrate, sodium salts of orthophosphoric acid and
polyphosphoric acid (as linear phosphate with a degree of polymerization
up to 6 units) not exceeding 0.3 per cent by weight of the finished product.
Such additions need not be declared on the label. Condensed milk
unsweetened shall contain not less than 8.0 per cent milk fat and not less than 26.0 per cent milk solids

Skimmed milk, sweetened: The product obtained from cow or buffalo skimmed milk or a combination thereof by the partial removal of water and after addition of cane sugar. It may contain added refined lactose, calcium, chloride, citric acid and sodium citrate, sodium citrate, sodium salts of orthophosphoric acid and polyphosphoric acid (as linear phosphate with a degree of polymerization up to 6 units) not exceeding 0.3 per cent by weight of the finished product. Such addition need not be declared on the label. Condensed skimmed milk sweetened shall contain not less than 26.0 per cent of total milk solids and not less than 40.0 per cent sugar. The fat content shall not exceed 0.5 per cent by weight.

Skimmed milk, unsweetened (evaporated skimmed milk): The product obtained from cow or buffalo skimmed milk or their combination by partial removal of water. It may contain added calcium chloride, citric acid and sodium citrate, sodium, salts of orthophosphoric acid and polyphosphoric acid (as linear phosphate with polymerization degree up to 6 units). Condensed skimmed milk unsweetened shall contain not less than 20 percent total milk solids and not more than 0.5 percent by weight of fat content.

❖ Cream: The product of cow or buffalo milk or of a combination thereof which contains not less than 25 per cent milk fat.

❖ Dahi (curd): The product obtained by sourcing pasteurized or boiled milk by a harmless lactic acid or other bacterial culture. ‘Dahi’ may contain added cane sugar. ‘Dahi’ shall have the same minimum percentage of milk fat and milk solids-not-fat as the milk from which it is prepared.

❖ Ghee: 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 standards of quality of ghee produced in a state or union territory shall conform to the standards laid down under the PFA Rules.

❖ **Ice cream, chocolate ice cream, and kulfi:** The frozen product obtained from cow or buffalo milk or a combination thereof or from cream and/or other milk products, with or without the addition of cane sugar, dextrose, liquid glucose, dried liquid glucose, eggs, fruits, fruit juices, preserved fruits, nuts, chocolate, edible flavours and permitted food colours. It may contain permitted stabilizers and emulsifiers, not exceeding 0.5 per cent by weight. The mixture shall be suitably heated before freezing. The product shall contain not less than 10.0 per cent milk fat, 3.5 per cent protein and 36.0 per cent total solids except when any of the aforesaid preparation contains fruits or nuts or both, the content of milk fat may proportionately be reduced but shall not be less than 8.0 per cent by weight. Starch may be added to a maximum extent of 5.0 per cent under a declaration on the label. The standards for ice cream shall also apply to softy ice cream.

❖ **Infant milk food:** The product obtained by drying cow or buffalo milk or a combination thereof, or by drying standardized milk, with the addition of specific carbohydrates (cane sugar, dextrose and dextrines, maltose or lactose), iron salts and vitamins. It shall be free from starch and antioxidants. Its moisture content shall not be more than 5.0 per cent, milk fat content not less than 18.0 per cent and not more than 28.0 per cent, total carbohydrates not less than 35.0 per cent, milk proteins not less than 20.0 per cent, total ash not more than 8.5 per cent, ash insoluble in dilute hydrochloric acid not more than 0.05 per cent, iron (as Fe) not less than 4.0 mg/100gms and vitamin A content not less than 15 I u/g. The process used in drying shall be indicated on the label. Infant milk food shall not show Standard plate count of more than 50,000 per gm. The solubility index minimum percent of the product shall conform to the following standards:
Roller-dried 85.0; Spray-dried 98.5. The product shall be packed in hermetically sealed containers and the label shall bear the date by which the products are to be consumed.

❖ Khoya: The product obtained from cow or buffalo or goat or sheep milk or a combination thereof by rapid drying. The milk fat content shall not be less than 20 per cent of the finished product.

❖ Malai: The product rich in butter fat prepared by boiling and cooling cow or buffalo milk or a combination thereof. It shall contain not less than 25 per cent milk fat.

❖ Milk Ices or Lolllies: The frozen product obtained from milk, skimmed milk, or milk product with or without the addition of cane sugar, pectrose, liquid glucose and dried liquid glucose, eggs, fruits, juices, nuts, chocolate, edible flavours and permitted food colours. It may contain permitted stabilizers not exceeding 0.5 percent of the product. The mixture shall be suitably heat-treated before freezing. The product shall contain not more than 2.0 per cent milk fat, not less than 3.5 per cent proteins and not less than 20.0 per cent total solids.

❖ Milk powder: The product obtained from cow or buffalo milk or a combination thereof or from standardized milk by the removal of water. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of orthophosphoric acid and poly-phosphoric acid (as linear phosphate with a degree of polymerization up to 6 units) not exceeding 0.3 per cent by weight of the finished product and 0.01 per cent of butylated hydroxyanisole (BHA) by weight of the finished product. For improving dispersibility, it may contain lecithins to a maximum limit of 0.5 per cent under label declaration. Milk powder shall contain not more than 5.0 per cent moisture and not less than 26.0 per cent milk fat. The maximum acidity expressed as lactic acid shall not be more than 1.2 per cent. The
plate count shall not exceed 50,000 per gram, and E coli shall not exceed 90 per gram. The solubility index minimum percent of the product shall be as follows: Roller-dried, 85.0; Spray-dried, 98.5. The process of drying shall be mentioned on the label. The spray-dried product shall be packed in hermetically sealed containers when the net quantity exceeds 510 gm.

**Skimmed:** The product obtained from cow or buffalo milk or a combination thereof by the removal of water. It may contain added calcium chloride, citric acid and sodium citrate, sodium salts of orthophosphoric acid (as linear phosphate with a degree of polymerization up to 6 units) not exceeding 0.3 per cent by weight of the finished product. Such addition need not be declared on the label. Skimmed milk powder shall not contain more than 1.5 per cent milk fat and moisture shall not exceed 5 per cent. The total acidity expressed as lactic acid shall not exceed 1.5 per cent. The plate count shall not exceed 50,000 per gm and E coli shall not exceed 90 gm. The solubility shall be as follows: Roller-dried 85.0; Spray-dried 98.5.

**Skimmed, partly:** The product obtained from partly skimmed cow or buffalo milk or a combination thereof by the removal of water. It may contain added calcium chloride, citric acid and sodium citrate, sodium salts of orthophosphoric acid (as linear phosphate with a degree of polymerization up to 6 units) not exceeding 0.3 per cent by weight of the finished product. Such additions need not be declared on the label. Partly skimmed milks powder shall not contain more than 5.0 percent moisture and fat content of the product shall be between 1.6 and 24.0 per cent. Butylated hydroxyanisole (BHA), not exceeding 0.01 percent by weight of the finished product, may be added. The exact fat content shall be indicated on the label. The minimum solubility/solubility index minimum percent of the product shall conform to the following standards: Roller-dried, 85.5. The process of drying shall be mentioned on the label. The
Spray-dried products shall be packed in hermetically sealed containers when the net quantity exceeds 510 gms. Partly skimmed milk powder (sour) used by the industry like bakery may contain sodium bicarbonate as a neutralizer, provided that the resultant product is labeled as "Unfit For Direct Consumption".

1.5 BUTTER

A. INTRODUCTION:

Butter leads amongst the milk products manufactured in developed dairying countries of the world today. Butter serves as the balance wheel of the dairy industry; Surplus milk is converted into butter while during times of scarcity the milk intended for butter-making is used for more essential products.

B. HISTORY:

The art of butter-making has a long history. The manufacture of creamery butter has been confined to the 'colder' regions of the world, where gravity creaming has been successful. References to butter are found in the Old Testament. In the past, butter was an article of commerce and a sign of wealth. Upto the middle of the nineteenth century, factory butter-making was unknown; most butter was made on the farm from cream obtained by gravity creaming. However, with the development of the centrifugal cream separator (1879), Fat test (Babcock, 1890; Gerber, 1892), butter churns artificial refrigeration, etc., factory butter-making developed rapidly.

C. DEFINITION:

Butter may be defined as a fat concentrate which is obtained by churning cream, gathering the fat into a compact mass and then working it.

According to PFA Rules (1976), table (creamery) butter is the product obtained from cow or buffalo milk or a combination thereof, or from cream or curd obtained from cow or buffalo milk or a combination thereof, with or without the addition of common salt and annatto or carotene as colouring matter. It
should be free from other animal fats, wax and mineral oils, vegetable oils and fats. No preservative except common salt and no colouring matter except annatto or carotene may be added. It must contain not less than 80 per cent by weight of milk fat not more than 15 per cent by weight of curd and not more than 3 per cent by weight of common salt. Di-acetyl may be added as a flavouring agent but if so used, the total di-acetyl content must not exceed 4 ppm. Calcium hydroxide, sodium bicarbonate, sodium carbonate, sodium polyphosphates may be added, but must not exceed the weight of butter as a whole by more than 0.2 per cent.

D. CLASSIFICATION:

Different kinds of butter are found in the market. These differ in the type of cream from which they are made and with variations in the manufacturing process. Unless specifically mentioned, the different kinds of butter may or may not be salted. A brief description of several kinds of butter is as follows:

❖ **Pasteurized cream butter:** This is usually made from pasteurized sweet cream. Such butter usually has a milder flavour than that made from similar cream which is not pasteurized.

❖ **Ripened cream butter:** This is made from cream in which a pleasant delicate aroma has been developed before churning by ripening (i.e. inoculating the cream with a butter culture and holding it at a desired temperature). Property made, ripened cream butter has a delicate flavour which is sometimes referred to as ‘real butter flavour’.

❖ **Unripened cream butter:** This is made from unripened cream. The flavour of such butter is usually mild.

❖ **Salted Butter:** Butter in which salt has been added.

❖ **Unsalted butter:** This types of butter contains no added salt.

❖ **Sweet cream butter:** In this case, the acidity of the churned cream does not exceed 0.20 per cent.
- **Sour cream butter**: This is made from cream which has more than 0.20 percent acidity.
- **Fresh butter**: This type of is such butter is not presented in cold storage and is normally consumed within 3 weeks.
- **Cold storage butter**: It is stored at a temperature of about 18°C (0°F for sometime. (Generally cold storage butter is one to six months old when offered for retail trade.)
- **Dairy butter**: This is made on a farm. It is usually made from non-pasteurized sour cream which has not been standardized for acidity. This butter generally has a sour flavour due to the high acid content of the cream.
- **Creamery butter**: This is made in a creamery or dairy factory. It is more uniform in quality than 'dairy butter'.

**E. COMPOSITION:**

According to the PFA Rules (1976), table/creamery butter should contain not less than 80 per cent fat, not more than 1.5 per cent curd and not more than 3.0 per cent common salt. The typical composition of Indian butter is given as follows:

**TABLE NO.: 1.2**

**COMPOSITION OF BUTTER**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butter fat</td>
<td>80.2</td>
</tr>
<tr>
<td>Moisture</td>
<td>16.3</td>
</tr>
<tr>
<td>Salt</td>
<td>2.5</td>
</tr>
<tr>
<td>Curd</td>
<td>1.0</td>
</tr>
</tbody>
</table>

*Note: The standards for composition of butter are prescribed either as 80 per cent fat or 16 percent moisture.*
F. FOOD AND NUTRITIVE VALUE:

Butter is very high in fat and fat-soluble like vitamins A, D, E and K.

FIGURE NO.: 1.2
Method of Manufacturing, Packaging and Storage of Butter
(Flow diagram of manufacture)

- Receiving Milk
- Pre-heating (35-40°C)
- Separation (Centrifugal)
- Grading
- Weighing
- Sampling
- Testing
- Neutralization
- Cream
- Standardization (35-40% Fat)
- Pasteurization (82-88°C/No hold)
- OR
- Vacuum
- Cooling (20-22°C)
- Ripening (20-22°C)
- Ageing (5-10°C)
- Churning
- Washing
- Salting and working
- Packaging and storage (-23 to -29°C)
1.6 CHEESE

A. INTRODUCTION:
Cheese, like butter, also functions as the balance wheel of the dairy industry in developed dairying countries. An insignificant amount of milk is annually converted into cheese in India, mainly of the cheddar type.

The manufacture of cheese did not develop in India during the past mainly because animal rennet could not be used by Indians (mostly Hindus), who considered cow slaughter sinful. However they discovered a plant known as 'Withania Coagulans', the seeds of which coagulated milk, and this helped in the preparation of Indian cheese or paneer on a very limited scale. The non-acceptability of rennet even today by the vast majority of the population (consisting of orthodox vegetarians) together with a lack of taste for cheese, besides certain other factors, have impeded the growth of the industry in this country.

B. DEFINITION:
Cheese has been defined by Davis as a product made from the curd obtained from milk by coagulating the casein with the help of rennet or similar enzymes in the presence of lactic acid produced by added or adventitious microorganisms, from which part of the moisture has been removed by cutting, cooking and/or pressing, which has been shaped in a mould, and then ripened by holding it for some time at suitable temperature and humidity.

According to the PFA Rules (1976), (hard) cheese means the product obtained by draining after the coagulation of milk with a harmless milk coagulating agent, under the influence of harmless bacterial cultures. It shall not contain any ingredients not found in milk, except coagulating agent, sodium chloride, calcium chloride (anhydrous salt not exceeding 0.02 percent by weight, annatto or carotene colour; and may contain certain emulsifiers and/or stabilizers, namely citric acid, sodium citrate or sodium salts of orthophosphoric acid and polyphosphoric acid not exceeding 0.2 percent by
weight; wax used for covering the outer surface should not contain anything harmful to the health. In case the wax is coloured, only permitted food colours may be used. Hard cheese shall contain not more than 43.0 percent moisture and not less than 42.0 percent milk fat of the dry matter. Hard cheese may contain 0.1 percent of sorbic acid or its sodium, potassium or calcium salts; or 0.1 percent of nicin.

C. HISTORY:

Cheese is one of the oldest foods of mankind. It was a prominent article of the Greek and Roman diet as much as 2500 years ago. It is referred to in the Old Testament several times. Probably cheese was made accidentally in the stomachs of animals carrying milk; the milk-clotting enzymes of the stomach converted the liquid milk into a solid mass or junket.

Until 1850, cheese was made in the ‘farmhouse’. The period 1860 brought into light the ‘factory system’.

Cheddar cheese originated in the town of Cheddar located in the county of Somerset in South-Western England. Cheddar is probably the best-known cheese in the world. Many variants are now recognized, such as American, Australian, New Zealand, Canadian and Indian Cheddar.

Modern cheese-making technology has advanced through the years and the data is given below:

About 1870: Commercial rennet preparation was put on the market by Hansen in Denmark.

About 1900: Use of titratable acidity measurements to control acidities in cheese making.

- Introduction of pure cultures of lactic streptococci as ‘starters’.
- Pasteurization of cheese milk to destroy pathogenic micro-organisms.
- Refrigerated curing of cheese.
DAIRY PRODUCTS INDUSTRY IN INDIA – AN OVERVIEW

• Processed cheese making.

In recent years

• Mechanization of cheese making.

• New methods of packaging.

D. SCIENTIFIC BASIS OF CHEESE MAKING:

This has been stated by Davis as follows:

❖ All cheese, irrespective of the country of origin and the methods of manufacture, possess certain characteristics in common:

• They are made from the milk of certain mammals

• The first stage is souring/ripening

• The second stage is clotting/coagulation by rennet or a similar enzyme preparation

• The third stage is the cutting or breaking up of the coagulum or junket to release the whey

• The fourth stage is the consolidation or ‘matting’ of the curd

• The fifth stage is the maturing of green cheese in some type of container

❖ The above five stages are common to all types of cheese, but the conditions may vary considerably. The chief factors responsible for differences in the final cheese are:

• The type of milk used

• The degree of souring and the type of souring organisms added

• The temperature of renetting and subsequent ‘cooking’ of the curd in the whey

• The method and fineness of cutting or of breaking up the curd

• The treatment of the curd after separation from the whey
• The milling and salting of the curd before placing it in the hoop or mould
• The pressure applied to green cheese
• The time, temperature and relative humidity of curing
• Special treatment such as pricking or stabbing the cheese, bathing in brine, and surface treatment to produce a certain type of coat.

❖ These variables, which are under the control of the cheese maker, all exert an influence on the physical chemical and micro biological changes which take place successively in the milk, coagulum curd and cheese

❖ From the scientific point of view, cheese making is essentially the controlled syneresis of the rennet milk coagulum, the expulsion of moisture being affected by:

• Acid development – The pH falling from 6.6 to about 5
• Warmth – The temperature being raised to 31°C (88°F) for renneting and to about 38°C for cooking the curd
• Repeated cutting of the curd

The combined effect of these factors is to decrease the moisture from 87 percent in milk to about 40 per cent in green cheese.

E. CLASSIFICATION:

It is reported that there are probably about twenty distinct classes/types/varieties of cheese in the world, although they are given over a thousand different names. Cheese can be classified according to the following systems:

❖ Geographical considerations: Country, valley, institution, town or region where first produced/marketed.
❖ Type of milk: Cow, sheep, goat, buffalo.
Method of Manufacture: Temperature of cooking, degree of acidity, fineness of cutting etc.; These affect moisture retention which in turn all firmness (hardness, softness) and also the rate of ripening.

General appearance: Flavour, size, colour, maintaining quality.

Physical and rheological properties: Very hard (less than 25 per cent moisture); hard (25–36 per cent moisture); semi-hard (36–40 per cent moisture): and soft (40 per cent moisture).

Chemical analysis: Water, calcium, sodium chloride, casein, lactose, fat-acidity contents.

Micro biological properties: Bacteria ripened, mould-ripened, un-ripened etc.

The factors that influence the resultant cheese from a lot of milk are: Types of organisms added enzymes added acid development, temperature and time used for cooking the curd, amount of salt added, moisture content of cheese, etc.

F. FOOD AND NUTRITIVE VALUE:

Cheese has high food and nutritive value:

(i) It is an excellent source of milk proteins;
(ii) A rich source of calcium and phosphorus;
(iii) An excellent source for several fat-soluble vitamins, such as A, D, E and K;
(iv) A concentrated form of energy; cheddar cheese gives about 400 calories /100 g.;
(v) Both palatable and digestible; these is practically no waste.
G. COMPOSITION:

The average composition of some of the important varieties of cheese as given below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Moisture</th>
<th>Fat</th>
<th>Protein</th>
<th>Ash and Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick</td>
<td>42.5</td>
<td>30.7</td>
<td>21.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Camembert</td>
<td>47.9</td>
<td>26.3</td>
<td>22.2</td>
<td>4.1</td>
</tr>
<tr>
<td>Cheddar</td>
<td>36.8</td>
<td>33.8</td>
<td>23.7</td>
<td>5.6</td>
</tr>
<tr>
<td>Cottage</td>
<td>69.8</td>
<td>1.0</td>
<td>23.3</td>
<td>1.9</td>
</tr>
<tr>
<td>Cream</td>
<td>42.7</td>
<td>39.9</td>
<td>14.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Edam</td>
<td>38.1</td>
<td>22.7</td>
<td>30.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Gorgonzola</td>
<td>37.3</td>
<td>34.7</td>
<td>25.2</td>
<td>3.8</td>
</tr>
<tr>
<td>Limburger</td>
<td>54.8</td>
<td>19.6</td>
<td>21.3</td>
<td>5.2</td>
</tr>
<tr>
<td>Gruyere</td>
<td>30.0</td>
<td>28.2</td>
<td>33.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Neufchatel</td>
<td>52.1</td>
<td>23.5</td>
<td>19.3</td>
<td>5.0</td>
</tr>
<tr>
<td>Parmesan</td>
<td>17.0</td>
<td>22.7</td>
<td>49.4</td>
<td>7.6</td>
</tr>
<tr>
<td>Romano</td>
<td>29.6</td>
<td>27.7</td>
<td>31.2</td>
<td>8.7</td>
</tr>
<tr>
<td>Roquefort</td>
<td>38.7</td>
<td>32.2</td>
<td>21.4</td>
<td>6.1</td>
</tr>
<tr>
<td>Sapsago</td>
<td>47.6</td>
<td>2.0</td>
<td>41.6</td>
<td>11.9</td>
</tr>
<tr>
<td>Swiss</td>
<td>33.0</td>
<td>30.5</td>
<td>30.4</td>
<td>4.2</td>
</tr>
<tr>
<td>Stilton</td>
<td>33.6</td>
<td>31.2</td>
<td>29.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Gouda</td>
<td>38.1</td>
<td>24.5</td>
<td>29.6</td>
<td>6.1</td>
</tr>
</tbody>
</table>
FIGURE NO.: 1.3
Method of Manufacturing, Packaging and Storage of Cheese
(Flow diagram of manufacture)

- Receiving Milk
- Pre-heating (35-40°C)
- Filtration/Clarification
- Standardization
- Pasteurization (63°C/30 min.)
- Adding Starter (Ripening) 31°C
- Adding colour
- Adding Rennet (Renneting (31°C)
- Coagulation/Setting
- Cutting
- Cooking (up to 37-39°C)
- Drainage of whey
- Cheddaring
- Milling
- Salting
- Hooping
- Dressing
- Pressing
- Drying
- Paraffining
- (Curing/Maturing)
1.7 CONDENSED MILK

A. INTRODUCTION AND HISTORY:

The advent of condensed milk belongs to the nineteenth century. In 1809, Nicholas Appert (1749–1840), a French Food Scientist, announced his discovery of means preserving milk (without the admixture of sugar or other preservatives) by the following method:

The milk was condensed by heating it in an open vessel placed in a water bath over fire, to about two-thirds of its original volume. The condensed milk was strained, cooled, poured into glass bottles, filling them up to the brim and corking them tightly. The bottles so filled and sealed were then held in a boiling water bath for two hours. The milk so treated was found to have very good keeping quality.

The commercially successful manufacture of condensed milk was initiated by the American, Gail Borden (1801–74), who is known as 'the father of the process of milk condensing'. Borden experimented for some wheat ten years before he finally decided that a semi-fluid state, produced by evaporation in vacuo, was the best form of preservation. In 1856, he received a patent both from U.S.A. and England. Records show that Borden manufactured sweetened condensed milk sold under the famous Eagle Brand label as early as 1856.

Around 1860, the Anglo-Swiss Condensed Milk Co. was organized in Switzerland by the American brothers: Charles A. Page and George H. Page, with the assistance of Swiss and English capital. This company prospered and grew rapidly in Europe. Around 1880, it extended its operations in U.S.A., but in 1902 it sold its American interests to Borden. In 1904, it consolidated with Henry Nestle of Switzerland forming the Nestle Condensed Milk Company.

The basic principle in the process of preserving unsweetened condensed milk by heat-sterilization was introduced by John B. Meyenberg, a Swiss, who was an operator in the original plant of the Anglo-Swiss Condensed Milk Co., Switzerland. He migrated to the USA in 1884, and in the same year was
granted a basic patent on his invention of a sterilizer. Later in 1884 and in 1887, he was granted patents on his process of preserving milk. His process patents sterilization by steam under pressure at a temperature not exceeding 116°C (240°F), while the sealed cans were continuously agitated by the revolving reel. This innovation provided the basis for a new industry.

The fundamental equipment used in the early days of the industry has not changed very much in principle. Condensation is still largely done in the vacuum pan or vacuum evaporator under the Gail Borden process, and sterilization is done by steam under pressure in sterilizers embracing the principles introduced by John B. Meyenberg.

In India, in 1961 Amul Dairy was credited with the first-ever commercial production of sweetened condensed milk under standard techniques.

B. DEFINITION:
Condensed milks are the products obtained by evaporating part of the water of whole milk, or fully or partly skimmed milk, with or without the addition of sugar. The term 'condensed' milk is commonly used when referring to 'full-cream sweetened condensed milk', while the term 'evaporated milk' is commonly used when referring to 'full cream unsweetened condensed milk'. Skimmed milk products are known as 'sweetened condensed skim milk' and 'unsweetened condensed skim milk' respectively. The ratio of concentration of milk solids is about 1:2.5 for full-cream products and 1:3 for sweetened condensed skim milk.

C. TYPES OF CONDENSED MILK:
According to the PFA Rules (1976) the various types of condensed milk have been specified as follows:

- **Unsweetened condensed milk** (evaporated milk) is the product obtained from cow or buffalo milk or a combination thereof, or from standardized milk, by the partial removal of water. It may contain added Calcium Chloride, Citric acid and Sodium citrate, Sodium salts, Orthophosphoric
acid and Polyphosphoric acid not exceeding 0.3 percent by weight of the finished product. Such additions need not be declared on the label. Unsweetened condensed milk should contain not less than 8.0 per cent milk fat, and not less than 26.0 per cent milk solids.

- **Sweetened condensed milk** is the product obtained from cow or buffalo milk or a combination thereof, or from standardized milk, by the partial removal of water and after addition of cane sugar. It may contain added refined Lactose, Calcium chloride, Citric acid and Sodium citrate, Sodium salts or Orthophosphoric acid and Polyphosphoric acid not exceeding 0.3 percent by weight of the finished product. Such additions need not be declared on the label. Sweetened condensed milk should contain not less than 9.0 percent milk fat, not less than 31.0 percent total milk solids and not less than 40.0 percent cane sugar.

- **Unsweetened condensed Milk** (Evaporated Skimmed Milk) is the product obtained from cow or buffalo skim milk or a combination thereof by the partial removal of water. It may contain added Calcium chloride, Citric acid and Sodium citrate, Sodium salts of Orthophosphoric acid and Polyphosphoric acid not exceeding 0.3 percent by weight of the finished product. Such additions need not be declared on the label. Unsweetened condensed skimmed milk should contain not less than 20.0 per cent total milk solids. The fat content should not exceed 0.5 percent by weight.

- **Sweetened condensed skim milk** is the product obtained from cow or buffalo skimmed milk or a combination thereof by the partial removal of water and after addition of cane sugar. It may contain added refined Lactose, Calcium chloride, Citric acid, Sodium citrate, Sodium salts of Orthophosphoric acid and Polyphosphoric acid not exceeding 0.3 percent by weight of the finished product. Such additions need not be declared on the label. Sweetened condensed skimmed milk should contain not less than
26.0 percent of total milk solids and not less than 40.0 percent cane sugar. The fat content should not exceed 0.5 per cent by weight.

D. ACCORDING TO THE USES:

❖ **Plain Condensed Milk** is unsweetened condensed milk made from whole milk partly skimmed milk or entirely skimmed milk, and condensed to 2.5 to 4:1. It is used in ice cream factories and bakeries. The product is neither sterile nor preserved by sugar. Its keeping quality is similar to that of high quality, efficiently pasteurized milk.

❖ **Superheated Condensed Milk** is plain condensed milk superheated by blowing Jive steam towards the end of the condensing period. The major purpose of superheating is to increase the viscosity. It is used in ice cream factories and bakeries, where it is believed to yield better results than plain condensed milk.

❖ **Frozen Condensed Milk** is plain condensed milk frozen so that it can be stored for a longer period. It is used largely in ice cream factories.

E. COMPOSITION AND STANDARDS:

The detailed composition of condensed milk is given below:

**TABLE NO.:1.4**

**DETAILED COMPOSITION OF CONDENSED MILKS (In %)**

<table>
<thead>
<tr>
<th>Type of Condensed Milk</th>
<th>Water</th>
<th>Total Solids</th>
<th>Fat</th>
<th>Milk Solids not-fat</th>
<th>Protein</th>
<th>Lactose</th>
<th>Total Milk Solids</th>
<th>Ash</th>
<th>Sucrose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condensed Milk</td>
<td>26.0</td>
<td>74.0</td>
<td>9.0</td>
<td>22.0</td>
<td>8.3</td>
<td>12.2</td>
<td>1.5</td>
<td>31.0</td>
<td>43.0</td>
</tr>
<tr>
<td>Evaporated Milk</td>
<td>31.0</td>
<td>69.0</td>
<td>9.0</td>
<td>22.0</td>
<td>8.3</td>
<td>12.2</td>
<td>1.5</td>
<td>31.0</td>
<td>---</td>
</tr>
<tr>
<td>Skim Sweetened</td>
<td>29.0</td>
<td>71.0</td>
<td>0.5</td>
<td>25.5</td>
<td>9.3</td>
<td>14.0</td>
<td>2.2</td>
<td>26.0</td>
<td>45.0</td>
</tr>
</tbody>
</table>

*Note: Composition of unsweetened condensed skim milk has not been included, as this product is rarely manufactured.*
The Standard specification for sweetened condensed milks, whole or skim, are given below:

**TABLE NO.: 1.5**

**STANDARD SPECIFICATION FOR CONDENSED MILKS**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Requirements for Condensed milk</th>
<th>Requirements for Skim sweetened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total milk solids (% wt.) Min.</td>
<td>31.0</td>
<td>26.0</td>
</tr>
<tr>
<td>Fat (% wt.)</td>
<td>Not less than 9.0</td>
<td>Not more than 0.5</td>
</tr>
<tr>
<td>Sucrose (% wt.) Min.</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Acidity (% lactic) Max.</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td>Bacterial count (per g.)</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Coliform count (per g.)</td>
<td>-ve</td>
<td>-ve</td>
</tr>
<tr>
<td>Yeast and mould count (per g.) Max.</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**F. FOOD AND NUTRITIVE VALUE FOR CONDENSED EVAPORATED MILKS**

Both have high nutritive value. Both are rich in fat and fat soluble vitamins A, D, E and K, body-building proteins, bone-forming minerals and energy-giving lactose. Further, while condensed milk is especially high in energy sucrose, evaporated milk is suitable for feeding the infants since it makes soft curd which is easily digested. There is some loss of vitamin B₁ (30 - 50%) and vitamin C (60 - 100%) caused by sterilization in evaporated milk. However, milk is a poor source of vitamin C. Sterilization is reported to have a minor effect on the biological value and digestibility of milk-proteins.

**G. ROLE OF MILK CONSTITUENTS IN CONDENSED MILKS:**

- **Milk Fat:** Imparts a rich and pleasing flavour, soft body and smooth texture to both condensed and evaporated milks. Affects viscosity. Significant in flavour problems, such as rancidity, tallowiness etc.

- **Milk Proteins:** Technologically of great importance. Their pI reactions to processing-heat largely determine the heat stability and viscosity of condensed milks.
- **Milk Sugar**: It plays an important role in the successful control of the texture of condensed milk. The size of lactose crystals determines the relative smoothness of condensed milk, and is controlled by the procedure used for the cooling and crystallization of this product.

- **Mineral Salts**: These particularly calcium and magnesium together with citrates and phosphates control the salt-balance and heat-stability of milk. A disturbed salt-balance causes objectionable heat-coagulation of milk.

**FIGURE NO.: 1.4**

**Method of Manufacturing, Packaging and Storage**

**Condensed Milk**

(Flow diagram of manufacture)

- Receiving milk
- Filtration/Clarification (38-40°C)
- Standardization
- Forewarming/Pre-heating (115-118°C/No HOLD)
- Addition of sugar
- Condensed (2.5:1)
- Homogenization
- Cooling and crystallization
  - Homogenization
  - Packaging
  - Storage (10°C)
H. USES OF CONDENSED AND EVAPORATED MILKS:

Condensed Milk
- For reconstitution into sweet milk drinks;
- In tea or coffee;
- In ice cream preparation;
- In candy and confectionary;
- In prepared foods

Evaporated Milk
- For reconstitution into milk for feeding infants and persons with weak stomachs, etc.;
- In ice cream;
- In tea and coffee.

1.8 DAIRY WHITENER

A. INTRODUCTION:

Today, the production of dried milks and milk products has become an increasingly important segment of the dairy industry. The world’s recorded annual output of dried milks and some milk by-products in 1969 (vide FAO Production Year Book, 1970) was 4.2 million tonnes, the contribution of India being 31.1 thousand tonnes, i.e. 0.7% of the total. There are definite indications of greater future production of dried milks and milk products due to their better keeping quality, their requiring less storage space and lower shipping costs. All of which are economically attractive. More non-fat dry milk production takes place than whole milk powder production, due to the high keeping quality of the former.

The ultimate aim of the industry is to obtain dry products which, when recombined with water, give little or no evidence of detrimental change compared to the original liquid product. While the reconstituted non-fat dry milk is nearly comparable in flavour to the original skim milk, much
improvement needs to be made with dry whole milk. The other aims are to ensure good keeping quality and a low manufacturing cost.

Dry milk provides a means of handling the excess milk supply in a dairy factory during the flush season, while in the lean season, that meant for the production of dry milk can be diverted to market milk. Thus dry milk may be called the balance wheel of the dairy industry today.

In India, the first-ever commercial production of spray dried milk was started by AMUL Dairy, Anand, in 1955. The production of some dried milk products in this country during the past few years.

**B. OBJECTS OF PRODUCTION:**

The objects or purposes of drying milk (and milk products) are:

- To remove the moisture so as to reduce bulk, thereby effecting a saving in storage space and packaging costs;
- To reduce the cost of transportation (due to reduced bulk);
- To improve the storage-life of the product (due to low moisture content);
- To provide a product this can be utilized for many food manufacturing operations;
- To conserve, as far as possible, the natural properties of the original raw material.

**C. HISTORY AND DEVELOPMENT:**

Marco Polo, the celebrated Venetian traveler of the thirteenth century, reported that the soldiers of Kublai Khan, a Mongol emperor, carried dried milk when on an excursion. Before it was used, water was added to a portion of the dried material. Mixing was accomplished by the horses' movements while traveling.
Next we hear of dried milk in tablet form made in 1810 by the French scientist, Nicholas Appert, by the air-drying of milk solids concentrated to a ‘doughy’ consistency.

In 1855, Grimwade of Britain developed a modified dry product from highly concentrated milk to which was added sodium (or potassium) carbonate and sugar. This semi-solid material was extruded into thin streams and dried in trays.

In 1902, Just of the USA was among the first inventors of a drum drier with two rolls. Numerous other types of drum driers were invented, but most of these were used to a limited extent. Vacuum drum driers were designed between 1889 and 1909. Among the early inventors of spray drying equipment were Percy of the USA (1872) and Stauf of Germany (1901). Peebles of the USA is known for his pioneering research to improve the reconstitutability of nonfat dry milk in water.

Dried milk or milk powder is the product obtained by the removal of water from milk by heat or other suitable means, to produce a solid containing 5 percent or less moisture. Whole milk, defatted milk or skim milk may be used for drying. The dried product obtained from whole milk is called Dried Whole Milk or Whole Milk Powder (WMP); and that from skim milk is known as Dried Skim Milk or Skim Milk Powder (SMP), or Non-Fat Dry Milk (NFDM). The various dried milk products are given specific names like dairy whitener, milk spray etc.

D. STANDARDS:

- **Whole Milk Powder**: According to the PFA Rules, 1976, whole milk powder is the product obtained from cow or buffalo milk, or a combination thereof, or from standardized milk, by the removal of water. It may contain calcium chloride, citric acid and sodium citrate, sodium salts of orthophosphoric acid and polyphosphoric acids, not exceeding 0.3 per cent by weight of the finished product, and 0.01 percent of butylated hydroxy
anisole (by weight) of the finished product. Such addition need not be declared on the label. Milk powder should contain not more than 5.0 per cent moisture and not less than 26.0 per cent fat. The total acidity expressed as lactic should not be more than 1.2 per cent. The standard plate count may not exceed 50,000/gm. and the Coli count may not exceed 90/gm. The maximum solubility index should be 15.0 for a roller-dried and 2.0 for a spray-dried product.

- **Skim Milk Powder**: According to the PFA rules (1976 skim milk powder is the product obtained from the skim milk of cow or buffalo milk, or a combination thereof, by the removal of water. It may contain added calcium chloride citric acid and salts of orthophosphoric acid and polyphosphoric acid, not exceeding 0.3 percent by weight of the finished product. Such addition need not be declared on the label. Skim milk powder may not contain more than 1.5 percent milk fat, and moisture may not exceed 5.0 percent. The total acidity expressed as lactic acid should not exceed 1.5 percent. The standard plate count should not exceed 50,000/gm. and the Coli count must not exceed 90/g. The maximum solubility index should be 15.0 for a roller-dried and 2.0 for a spray-dried product.

**E. ROLE OF MILK CONSTITUENTS:**

- **Milk Fat**: This may be present in dried milks or milk products either in the original globule, i.e. in emulsion form, or as free fat, i.e. in de-emulsified form. Free fat makes the dry product greasy and leaves an oily film on the reconstituted milk. The unstructured fatty acids of milk fat, e.g. oleic, play a profound role in oxidative deterioration. Free fat promotes oxidation. The phospholipids of milk appear to be responsible for the oxidized flavour. The rancid flavour of milk fat is primarily due to the liberation of butyric acid as a result of hydrolysis of glycerides through lipase action.

- **Milk Proteins**: Many of the problems of dairy technology revolve around the behaviour of the caseinate system and particularly on the aggregation
of casein particles by heat, salts, acid, etc. Milk proteins are readily subject to changes during heat-processing and to some extent during storage; the changes adversely affect their solubility, i.e. dispersibility. The heat-treatment destabilizes the proteins by inducing first stage denaturation and then irreversible denaturation (coagulation) as it becomes more severe. Some destabilization also occurs slowly during prolonged storage. Some proteins, probably β-lactoglobulin, appear to be the source of sulfydryl compounds associated with a cooked and caramelized flavour.

- **Milk Sugar:** This has an important role to play in the manufacture and storage of dried milk products. In freshly dried milk, the lactose is still present in the amorphous or glass (non-crystal line) state. In this form it is very hygroscopic and readily absorbs moisture upon exposure to the atmosphere, which induces crystallization. This absorbed humidity then causes the powder to become sticky, and then to cake. This tendency to stickiness and caking increases in the presence of lactic acidity.

Browning (colour defect) of dried milk products may be caused during manufacture, chiefly due to excessive temperature and long exposure to heat. Browning may also occur during storage; especially under conditions of high moisture, high storage temperature and packaging in air-packed containers all of which hasten and intensify browning.

- **Milk Salts:** These play an important part in influencing the physical state and physical stability of the milk proteins, particularly the caseinates. The well-known ‘salt balance’ theory of Sommer and Hart holds that optimum stability depends on a certain ratio of calcium and magnesium ions to those of citrates and phosphates. Minor changes in salt balance and pH easily upset this equilibrium and tend to destabilize and precipitate the casein particles. The resulting dried milk will have a low solubility (dispersability). Copper and iron exert a catalytic action in the oxidation of
milk lipids, which produces undesirable flavours in the dried milk products.

FIGURE NO.: 1.5

Method of Manufacturing, Packaging and Storage of dairy whitener
(Flow diagram of manufacture)

- Milk Concentrate
- Adjustable Pump
- Feeding
- Drying Drum
- Scraper
- Grinder
- Sifter
- Dried Product
1.9 CHOCOLATE

A. HISTORY AND DEVELOPMENT:

The development of cocoa, chocolate, and confectionery over the centuries has been a remarkable phenomenon. The cocoa tree is an unusual tree, with its cultivation confined to limited areas and climatic conditions. The processing required both in the areas where it is cultivated and in the factory is a complex example of human persistence and ingenuity.

Several developments have been responsible for progress in the industry, as the chocolate products as originally prepared by the natives of Central America would hardly be acceptable today. Until the early 1800s the only product was a very fatty chocolate drink prepared from the whole cocoa bean, sugar, and spices. In 1828, Van Houten of Holland invented the cocoa press, which removed a part of the cocoa fat from the bean, resulting in a powder with about 23 percent fat. This made the drink easier to prepare and digest. At the same time, the natural fat, cocoa butter, was released, making it possible to produce a fluid chocolate that could be molded and also used to cover other confectionery products. In England, during the 1840s, Fry, and later Cadbury, made chocolate bars.

Another major development was the invention of milk chocolate by Daniel Peters of Switzerland in 1876. The ground cocoa nib (the bean cotyledon) was processed with sugar and milk solids and the result was a product that today is the mainstay of the chocolate industry.

Cadbury's Dairy Milk chocolate was developed in the early 1900s and similar products by many other manufacturers followed. Since that time, the popularity of milk chocolate has increased astronomically, and with the development of mass-production molding machines that have helped to reduce its manufacturing cost, it is now available to almost everyone.

In the early days, the processing of milk for chocolate needed a method that would ensure the development of flavor and good shelf life. The American,
Milton Hershey, used a special cultured-milk process and Cadbury developed the Crumb process.

In the United States, Hershey and chocolate are synonymous. Hershey established the Hershey Chocolate Company around 1900, after selling his caramel-manufacturing business. After much experimenting, he developed his own method for making milk chocolate, and a factory was built in the rich Pennsylvania countryside where there were plentiful supplies of fresh milk.

The Swiss have also had a close association with chocolate. Chocosuisse, the Association of Swiss Chocolate Manufacturers, which was established in 1945, in the publication Chocologie trace the history and development of chocolate through the ages. Many of the early Swiss names cited there are still associated with chocolate products, including Suchard (1797-1884), Cailler (1796-1852), Sprungli (1816-1897), Lindt (1885-1909). Henri Nestle (1814-1890) came into the chocolate industry later and was more concerned with milk processing. Without Nestle's development of condensed milk, Daniel Peters would not have invented milk chocolate.

It is interesting to note that the chocolate industry has been associated with many philanthropists and humanitarians. Fry, Cadbury, and Rowntree were Quakers. Elizabeth Fry, the great social reformer, was a descendant of the family that built the first factory in England in 1728. Milton Hershey, a Mennonite, in 1909 established a school for orphan boys that today provides foster care for both boys and girls.
B. INGREDIENTS:

The basic ingredients required for chocolate manufacture are cocoa nibs, cocoa liquor, sugar, other sweeteners, cocoa butter, butter fat (oil), milk powder, milk crumb, and emulsifiers.

C. CHOCOLATE MANUFACTURING PROCESSES:

Manufacturing processes, whether for dark or milk chocolate, involve certain basic operations: preparation of ingredients, mixing of ingredients, refining of
the mixture, pasting or partial liquefaction of the refined mixture, conching (or an alternative process), and adjustment of viscosity and flavoring.

FIGURE NO.: 1.7

**Method of Manufacturing of chocolate**

1. Preparation of Ingredients,
2. Mixing of Ingredients
3. Refining of the Mixture,
4. Pasting or Partial Liquefaction of the Refined Mixture,
5. Conching (or Alternative Process),
6. Adjustment of Viscosity
7. Flavoring
1.10 CURRENT SCENARIO OF DAIRY PRODUCTS SEGMENT:

By the year 2005, the country will have at least 10 players in the processed food business having a sales turnover of Rs.3,000 crores or more each, according to the officials of a Mc Kinsey and Company.

A senior official of Mc Kinsey, who was engaged in the study of the country’s food industry, in association with the Confederation of Indian Industry (CII), said that businesses in soft drinks, dairy products and confectionery held potential in the country, along with packaged wheat flour, milk and bakery.

The CII - Mc Kinsey report titled “Food and Agriculture Integrated Development Action (FAIDA): Modernizing the Indian Food Chain”, was released recently in New Delhi in the presence of Mr. Jaipal Reddy, the Union Minister of Information and Broadcasting.

He said that the food industry would be the driving force behind the country’s economy in the near future, be benefiting both consumers and the domestic players. According to him, in terms of share in the country’s GDP, food held a major chunk of 26 per cent. In terms of employment, the food industry employed 61 per cent of the total employed.

Further he added that there was a huge potential in certain food sector such as processed meat and poultry, soft drinks, packaged atta (wheat flour), packaged milk, dairy products, confectionery, tea, coffee and bakery. It is estimated that, packaged milk & dairy products, to Rs.50,000 crores by year 2005.

He said that the local players would rule the basic food market in the future, despite the invasion of multinational companies. He quoted figures from other countries in support of his argument. In the liquid mild market, in New Zealand and the Netherlands, local players have a share of 100 per cent, while in Australia it was 90 percent.
Similarly, in the flour market, local players in Malaysia have 100 per cent market share, while in Thailand, local players own a 95 per cent market and in Philippines 90 per cent.

The CII President, requested the Union Government to take positive steps to boost the food processing industry. A former president of the chamber also asked if it was feasible for such growth in the food market in the era of excessive taxation on refrigeration infrastructure.

On doubts whether the local players will own a major share of the market or not, he said the basic food market was always domestically driven.

Other officials of CII added that recent trends indicated that the growth of demand for packaged food industry in rural areas was higher than that of the urban.

A. DAIRY MARKET IN INDIA:

India's dairy market is multi-layered. It's shaped like a pyramid with the base made up of a vast market for low-cost milk. The bulk of the demand for milk is poor in urban areas where individual requirement is small, maybe a glassful for use as whitener for their tea and coffee. Nevertheless, it adds up to a sizeable volume - millions of litres per day. In the major cities lies an immense growth potential for the modern sector. Presently, its milk distribution network, dispensing hygienically packed wholesome, quality pasteurized milk, serves barely 778 out of 3,700 cities and towns. According to one estimate, the packed milk segment would double in the next five years, giving both strength and volume to the modern sector. The narrow tip at the top is a small but affluent market for western type milk products.

- Growing Volumes: The effective milk market is largely confined to urban areas, inhabited by over 25 per cent of the country's population. An estimated 50 per cent of the total milk produced is consumed here. By the
end of the twentieth century, the urban population is expected to increase by more than 100 million to touch 364 million in 2000 a growth of about 40 per cent. The expected rise in urban population would be a boon to Indian dairying. Presently, the organized sector both cooperative and private and the traditional sector cater to this market.

The consumer access has become easier with the information revolution. The number of households with TV has increased from 23 million in 1989 to 45 million in 1995. About 34 per cent of these households in urban India have access to satellite television channel.

Potential for further growth: Out the three A’s of marketing - Availability, Acceptability and Affordability, Indian dairying is already endowed with the first two. People in India love to drink milk. Hence no efforts are needed to make it acceptable. Its availability is not a limitation either, because of the ample scope for increasing milk production, given the prevailing low yields from dairy cattle. It leaves the third vital marketing factor affordability. How to make milk affordable for the large majority with limited purchasing power is the essence of the challenge. One practical way is to pack milk in small quantities of 250 ml or in polythene sachets. Already, the glass bottle for retailing milk has given way to single-use sachets, which are more economical. Another viable alternative is to sell small quantities of milk powder in mini-sachets, adequate for two cups of tea or coffee.

Marketing Strategy for Dairy Products: Two key elements of marketing strategy: Focus on strong brands and, product mix expansion to include UHT milk, cheese, ice creams, butter, dairy whitener and spreads. The changing marketing trends will see the shift from generic products to the packaged quasi, regular and premium brands. The national brands will gradually edge out the regional brands or reduce their presence. The brand image can do wonders to a product's marketing as is evident from the
words of Perfume Princess. Coco Channel: In the factory, we pack perfume; in the market, we sell hope.

Emerging Dairy Markets

- **Food service institutional market**: It is growing at double the rate of consumer market

- **Defense market**: An important growing market for quality products at reasonable prices

- **Ingredients market**: A boom is forecast in the market of dairy products used as raw material in pharmaceutical and allied industries

- **Parlour market**: The increasing away-from-home consumption trend opens new vistas for ready-to-serve dairy products, which would ride piggyback on the fast food revolution sweeping the urban India.

India, with her sizable dairy industry growing rapidly and on the path of modernization, would have a place in the sun of prosperity for many decades to come. The one index to the statement is the fact that the projected total milk output over the next 15 years (1995-2010) would exceed 1457.6 million tonnes which is twice the total production of the past 15 years.

The alarm bells were not loud enough. The import of 17,000 tonnes of skimmed milk powder from Denmark and that too at zero duty a couple of years back had surely resulted in a political uproar from the frontline agricultural state of Punjab. A little tinkering in the import duty structure was drowned in the deafening chorus from the country's mainline economists who always feel agitated whenever any safeguard measures are adopted to protect the country's farmers. The promised restructuring to protect the domestic dairy industry, which in turn provides livelihood to millions of subsistence farmers, was soon forgotten.
Under political pressure, the government announced a two-tier import duty structure for milk, which it is finding it difficult to implement. In any case, the imposition of 60 per cent duty on milk powder imports (after allowing for 10,000 tonnes at 15 per cent duty) is unlikely to stop the flood of imports. But still the economists were unhappy as these measures actually restricted the earnings of the western farmers.

The dairy industry is however once again up in arms. This time the Indian dairy industry sees a deep conspiracy in the dumping of butter oil by major foreign players. New Zealand, with an import order of 12,000 metric tonne, has already dumped a large quantity of butter oil into India. Even after paying an import duty of 35.2 per cent, the butter oil imports have been at less than US $ 1,000 per tonne against the prevailing global price of US $1,300 per tonne. In simple terms, New Zealand's butter oil is roughly cheaper by Rs 15 a kg, made available at Rs 64.54 per kg compared to the prevailing international prices of Rs 87.40 per kg. and that too when New Zealand claims that it does not provide any subsidy to its dairy farmers.

The resulting crash in the domestic prices of butter oil was therefore expected. The price of butter oil (ghee) before the recent import was in the range of Rs.100 to Rs.120 per kg., which has subsequently come down by 10 to 15 percent. While the consumers are happy, the real price has to be paid by the dairy farmers. Since the Indian dairy farmers are paid on the basis of recovery of the fat (broadly ghee) in the milk has already suffered erosion in the milk value by 15 per cent.

While the imports were coming in, Finance Minister Yashwant Sinha was busy explaining the implications of Budget 2002-03. What he did not however explain was that one of the major decisions that he announced would in reality begin the end of the milk cooperatives. The decision to amend the Milk and Milk Products Order, 1992 (MMPO) so as to remove restrictions on new milk processing capacity actually spells a death-knell for the milk cooperatives, a
sector which provides economic empowerment to over 80 million people, mostly rural women. The decision means that private milk processing plants and companies can now set up dairy plants processing more than 10,000 litres a day without any registration that requires a declaration of a 'milk shed' area. What happens to the largest cooperative movement in the country in the milk sector is a lesson for other cooperative ventures.

It is not as if the country is faced with milk shortage that calls for increasing imports to meet the growing domestic requirement. In recent years, India has emerged as the biggest producer of milk with an output of 81 million tonnes in 2000-01, outpacing 72 million tonnes achieved in the United States. Indian milk production, however, in contrast to other milk producing countries, is characterized by millions of small and marginal farmers including landless milk producers for whom dairying is not only a business but also the main source of employment. On the other hand, milk currently generates more than 20 per cent of farm cash receipts in most advanced industrialized economies.

In India, it took nearly thirty years to achieve self-sufficiency in milk production, and in this process emerged as the biggest milk producer in the world. Ever since the launch of Operation Flood in 1969-70, before which the Indian dairy industry was in the depth of despair, the effort has been made to involve the farmers through a network of cooperatives, owned and controlled by farmers, with an intelligent mix of policies that provided incentive for enhancing productivity and production. More than 80 lakhs dairy farmers, mostly women, are members of more than 60,000 dairy cooperatives. The dairy cooperatives have been the road that has pulled millions of poor from the poverty trap.

And yet, the National Dairy Development Board (NDDB), which spearheaded India's white revolution, failed to stand up and speak on behalf of millions of dairymen in the cooperative institutions whose very survival is at stake. With Dr Verghese Kurien, the strong man of the Indian dairy cooperatives quietly
retiring, the NDDB has probably lost its tower of strength. It no longer is being revered for its stellar role in ushering milk 'self-sufficiency'. In fact, the government is trying all kinds of permutation and combinations thereby allowing the gains of the white revolution to be frittered away and not realizing. That dismantling the NDDB would put to an end the livelihood of millions of small and marginal farmers at the altar of market economy.

Coming back to the issue of trade, India is perhaps the only major milk producer, which has a negligible share in international milk trade. Even with 81 million tonnes of production, Indian export of skimmed milk powder and butter has rarely exceeded a few hundred tonnes. In contrast, the world's biggest exporter, New Zealand, with annual milk production of a mere 12 million tonnes, exports about 4.5 million tonnes of milk powder. This is essentially because India has a huge domestic market whereas the limited domestic market gives industrialized countries the added incentive to export.

Even before the WTO began asserting its mandate, the Indian government had been toying with the idea of opening up the vast Indian market for unrestrained imports of skimmed milk powder and milk products. Following the government's economic liberalization policy, milk powder, which used to be on the restricted list (for imports) was put on the open general license in 1995-96. With the import of skimmed milk powder touching an all-time high of over 17,000 tonnes two years back and that too at zero import duty, the pen-door policy to MNCs has placed the national milk grid in jeopardy. Despite the imports, market prices of milk have been on the rise. Synthetic and spurious milk has flooded the market, and as if this is not enough, milk has been diverted from the malnourished children and the burgeoning middle class to 'high-margin' products such as milk powder, chocolates and ice-cream.

The tarification of non-tariff barriers under the WTO has forced India to bind the import of milk powder at zero duty. This was primarily because milk powder import had so far remained on the restricted list and therefore was
devoid of any non-tariff barriers or what is known as quantitative restrictions (QRs). In comparison, New Zealand imposes a 12 per cent import duty and the United States and the European Union have 'bound' duties at a specific rate of US$ 865 and US$ 1,188 per tonne, respectively. The import of milk powder from Denmark into India was for instance contracted at US$1,400 per tonne, even as the US and the EU are providing a subsidy of US$ 1,028 and US$ 959 per tonne of subsidy. The import price, with the subsidy built-in, is substantially lower than the cost of production in India.

The logic behind allowing MNCs to import milk powder without countervailing duties is difficult to fathom, when their own government is giving them massive subsidies. The Producer Subsidy Equivalent, which measures the aggregate quantum of subsidy as a percentage of the value of the milk produced in 1997 stood at 82 per cent in Japan, 59 per cent in Canada, 54 per cent in the European Union, 47 percent in US and 23 per cent in Australia. Further, the per tonne subsidy of US $ 811 for milk powder declared by the EU in 1998 or the US $ 875 per tonne subsidy provided by the US under its Dairy Export Incentive Programme constituted roughly 55 per cent of the prevailing international price of US $ 1,500 per tonne the same year.

Such has been the high level of protection provided to milk producers by the developed countries that even with the stipulated reduction in both the volume and the amount of subsidies, the EU and the US can continue to flood and dump its highly subsidized milk and milk powder onto the unsuspecting developing countries, which have little safeguard mechanisms to protect their small dairy producers. The signs are therefore ominous. Highly subsidized imports of milk flowing into India will only reinforce the mechanism of further marginalisation of millions of milk producers. Thousands of dairy cooperatives, which literally pulled the poverty-stricken masses out into a path of economic emancipation will collapse faced with import of cheap and highly subsidized imports.
B. INTERNATIONAL MARKET FOR DAIRY PRODUCTS:

Operation flood, the world's largest integrated dairy development programme started in 1970 by the National Dairy Development Board (NDDB), has given the Indian dairy sector a newfound vigor and respectability.

In rural and semi-urban areas, animal husbandry generates jobs, especially in less developed areas like hilly and draught prone districts. In fact, during the 1980's, employment potential in the line-stock sector grew faster than in the agriculture sector as a whole. That was also the period when India's dairy farming expanded, especially in states which boasted high stocks of milk, like Punjab, Haryana and Rajasthan.

As a result, India's milk production touched 66 million tones in 1995-96, having grown annually at the rate of 4.5% world's record largest producer of the milk. But India's share in the world dairy trade is not very significant, the export earning from the line stock sector rare from Rs.792 crores in 1988-89 to Rs.1,672 crores in 1994-95.

World wide, according to the recently released second annual report on the world market for diary products. Products prepared by world trade organization (WTO) the prospects. Exist for an increase in milk production. The boom will be fuelled by further expansion in developing countries and Oceania (Australia and Newzealand). In the common wealth of independent states(CIS) and eastern Europe, however, milk production is likely to stabilize, with milk production shrinking in number and average dairy herd rise increasing. In these countries, the dairy processing industry appears to be getting more and more concentrated, a situation that can only hold promise for developing countries and India is especially well placed to capitalize on this opportunity.

The world trade in both skimmed and whole milk powders has risen overall, although production of skimmed milk powder declined in 1995. Exports of
butter and butter all picked up in 1995 due to growing demand from the Russian Federation and the near and far east countries.

Cheese was the bright spot in the world dairy trade. Not only did production rise, but prices for cheese remained firm during 1995. The WTO thinks that the fact that cheese is being produced more rapidly than mild indicates a progressive shift worldwide towards the production of value-added products.

For India, the Technology Mission on dairy development will supplement the efforts of Operation Flood. It will coordinate dairy development with various field-level programmes. The mission has set specific research goals and will focus on policy issues to sustain dairy development.

To do so, in this year’s budget, the department of animal husbandry and dairying of the ministry of agriculture has set apart Rs.11 crores, of which Rs.2 crores is meant for Operation Flood III. The budget has also earmarked Rs.39 crores as Central Plan outlay for the department. The dairy development component of this head provides for the integrated Dairy Development Programmes not covered by Operation Flood, as well as in hilly and backward areas. All these developments should hopefully spell out a bright future ahead for the industry.