Introduction
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"Khoa is an indigenous product produced by continuous heating of milk in an open pan with constant stirring cum scrapping till a semi solid substance is produced. This partially dehydrated product is called Khoa". In India about 7% of the total milk produced is converted into Khoa. Despite its high economic and nutritional importance the product has not received adequate attention. At Jhansi most of the Khoa is prepared in a small lots by constant heating. Neither the chemical composition of milk nor the degree of heat treatment has been standardized. Therefore this product could not be kept on sound industrial footing. Despite of the fact that it is being prepared since ancient times.

Research work and serious attempts should be made on this product with response to the methods of its manufacture, chemical composition, microbial quality and shelf life. Very little attempts have
been made to investigate physico-chemical and bio-chemical changes during the storage of Khoa.

Traditional methods of its manufacture have been employed in the research studies. Dried Khoa prepared from buffalo milk consists of 3.1% moisture, 33.8% fat, 27.2% protein, 30.6% lactose and 5.3% ash content.

Thus fat, protein, lactose are the major components of Khoa. Today the total Khoa production have been estimated over 300 million kilograms, worth about 500 crores. Generally it is prepared in the northwestern region of the country. The largest amount is produced in Uttar Pradesh, which produces about 36% of the total Khoa production of the country. At Jhansi three varieties of Khoa that is Desi, Agra and Shrivpuri are available. They differ in quality, colors and texture and uses. All these verities are in demand for making specific types of sweets. Its composition mainly depends on the initial components of milk. Its nutritive value is very high. It contains muscle-building proteins bone building calcium and minerals. It has energy giving fat and lactose. Apart from these it also contains fat-soluble vitamin A and B and fairly good amount of water-soluble vitamins. The cow milk Khoa has moisture 25.6%, fat 25.7%, protein 19.2%, lactose 25.5%, ash 3.8%, Iron 103 ppm and other trace elements. Buffalo milk Khoa has moisture 19.2%, fat 37.1%, protein 17.8%, lactose 22.1%, ash 3.6% and iron 101 ppm.

Lots of work is being conducted to standardize the technique of preparing smooth textured Khoa. Lots of commercial and semi commercial processes have been recommended, but still prototype continuous production unit so far could not be obtained. Attempts are
required to manufacture stainless steel fabricated units to overcome problems of metallic contaminations.

Most of the investigation on chemical composition of Khoa have been oriented to set minimum legal standards. Mostly commercial Khoa samples are collected from the local markets and analyzed to have approximate constituents. The chemical quality of Khoa varies to the quality of milk used, methods of preparation, degree of heating and manner of handling during storage. Mawa samples from local markets of Bombay show variation in chemical compositions. The National Dairy Research Institute Bombay (NDRI) provided average composition of 118 samples collected from various places in Bombay. It contained 27.2% moisture, 25.15% fat, 47.64% SNF and 17.98% lactose. Similarly Khoa sample from places as distant as Calcutta, Patna, Ban galore have variations in the chemical composition. In Bombay the moisture content varied from 11.39 to 44.60%. The standard for Khoa under the prevention of food Adulteration Act (1954) required that it should not contain more than 28.0% moisture. The dealer of Khoa complained for such low moisture level. Since good quality sweets could not be prepared from Khoa having such low moisture content. On a representation of the all India Mawa Vyapar Sangh, the question of quality standards of Khoa was further examined in 1970. It was decided that pending further instruction from the Central Ministry Of Health, no prosecution or penal action taken under the prevention of food Adulteration Act, 1954. This Act suggested that Khoa should contain a minimum of 20% milk fat irrespective of its moisture content. Variations in fat contents largely depend on the level of fat in milk and degree of concentration. The fat content of Khoa on dry matter basis averages 30.9% in Bombay.
The lactose, milk proteins and ash contents in Khoa also varies depending upon the type of milk used, extent of desiccation and addition of adulterants.

The yield of Khoa was influenced by the total solids in milk and the moisture content in the final product. Generally it ranges from 17.5 to 21.0% in cow milk and 20.5 to 23.4% in buffalo milk. On an average the yield is 18.3% in cow milk and 21.5% in buffalo milk.

Microbial studies in Khoa are mostly based to assess the standard of cleanliness by handing during production packaging transporting, caring and storage. These studies help to develop standards to ascertain the keeping quality of the product. A few attempts have been made to determine the bacteriological quality of market Khoa in terms of total count, acid producers, proteolytic, chromogenic, thermophilic, lypoalytic, spore count, yeast and mould count, coliform count and enterococcus count. The standard plate count of fresh Khoa ranged between 8000 to 15,00,000 per gm in market sample. The market samples of Khoa are heavily contaminated by acid producer’s proteolytic and chromogenic organisms. In general there is a rapid increase in the total bacterial count of Khoa during storage at 37°C. The spore count of fresh Khoa sample before packaging was 200 per gm according to Kumar et.al.; (1975). These represent the organism surviving the heat treatment. They are only a small percentage of total bacteria found in original milk.

The presence of yeast and moulds count in Khoa is quite undesirable since they produce discoloration and lypoalytic defect. Kumar et.al.; (1975) found that the initial yeast and mould count was 20 per gm which increase to 35 to 1480 per gm during 5 to 10 days storage at 35°C.
This occurrence of yeast and moulds may be actually due to the post manufacture contamination. Mucor is generally the most dominant genus among moulds. Aspergillus, Penicillium may be the other species of moulds.

Shelf life packaging and storage of Khoa. Generally the higher the storage temperature the lower is the keeping quality. The average storage life of Khoa made either from cow or buffalo milk is $37 \pm 1^\circ C$ is 7 days at 23 to 24$^\circ C$ 10 days and at 5$^\circ C$ at 25 days. It has been found that fungus being aerobic in nature cover the entire surface of the product and produce abnormal colors, flavor and appearance. Generally the storage of Khoa beyond 48 hrs at $37^\circ C$ results a rancid odor, brown discoloration and greeny appearance. It has been found that hot packaging ensure longer keeping quality than cold packaging. It has been reported that Khoa with initial moisture content of 10 to 25% has an average shelf life of 14 to 21 days when packed hot that is 80 to 90$^\circ C$. Storage of Khoa at refrigeration temperature has been found to increase its shelf life to 24 days. Addition of sugar prior to dehydration improves the keeping quality such as burfi and peda could be stored in good condition for 3 to 5 months. During storage lactic acid increases up to 0.3 to 0.5%. Some persons have reported that moulds growth can be prevented by wrapping the Khoa in butter paper. Spoilage of Khoa is generally noticed after at 5th days at room temperature and after 20 days at 5$^\circ C$. The wrapping in butter paper soaked in sodium propionate, pottassium sorbate increase the shelf life. And at the same time inhibits the growth of bacteria and reduces proteolysis. Addition of antioxidants like ascorbic acid, propyl gallate and lecithine did not improve the keeping quality. To use of sterilized container would be too costly for packaging material of Khoa.
However they offer great resistance to deterioration. The best resistance has been found in stainless steel followed by aluminum, brass and iron.

Work has also been done to prolong the period of storage using ultra violet rays. Such treatment develop oxidized flavor which may not be acceptable to the consumers. In such cases percentage of lactose and moisture decreases. Nicin has been observed to extend the storage life by more than one month at 10°C and 2 to 3 weeks at 30°C and 22°C respectively. The spoilage of Khoa is characterized by rancid flavor this is due to hydrolysis of fat by lipase enzyme. Sour flavor at low temperature is due to mouldy growth on the surface. The sour and acid flavor is due to the high acidity in the milk used.

The Bureau of Indian Standards has laid down quality specification for Khoa. The compositional required are given in the following Table -

<table>
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<th>BIS Specification for Khoa</th>
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<tr>
<td>Characteristics</td>
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<tr>
<td>Total solid (% by mass, min.)</td>
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<tr>
<td>Fat (% by mass, on dry basis, min.)</td>
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<tr>
<td>Total Ash (% by mass, on dry basis, max.)</td>
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<td>Titrable Acidity (as lactic acid - % by mass, max.)</td>
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The above three types of Khoa are described on the basis of its characteristics shape and texture. Pindi is because of the circular shape given to Khoa with the help of metallic moulds. In the preparation of Dhap, the product during Khoa making is taken out of the pan when it becomes viscous and starts leaving the pan surface. No working is required on the product. It is characterized by its loose sticky body and lumpy texture. Danedar or Granular Khoa is prepared form milk of slightly high acidity or by addition of a coagulant. It is characterized by its granular texture and uneven body. The size of the grains depends upon the amount of coagulant added. If citric acid is used, it should not exceed 0.1 % of the product.

**Innovative system of Khoa making**

The old system of making Khoa in karahi has been replaced by a double jacketed stainless steel kettle with or without an inbuilt scrapper. Steam is circulated in the jacket this provides a non-smoky heating system of uniform heating by controlling the steam pressure. Khoa produced by this methods is usually granular.

Now a day a continuous Khoa making system has been developed to produce 50 kilogram Khoa per hour by National Dairy Development Board Anand. It consists of steam jacked drum cylinder with rotary scrapper and milk inlet and outlet valve. Two steam jacked pans, two sets of reciprocating scrappers in the pans a power drive for the scrappers.

The research workers at National Dairy Research Institute (NDRI) upgraded the equipment by modifying the design and using stainless steel. Adequate precautions have to be taken to maintain uniform steam pressure in the jacket and continuous product flow. Many different types
of scrappers have been used by various workers and have tried to upgrade the production of Khoa through a continuous system. So far none of the continuous Khoa making system have incorporated the feature of reducing the granularity of the product to produce the smooth texture with fine particles. Effort should be made to incorporate some operations, which promote the sale of the acceptability of Khoa for sweet makers.

**Khoa Powder-**

Traditional methods of Khoa making leads to variations in its chemical composition, microbiological and textural qualities. Not much attention is pay towards the hygienic condition.

Surplus milk of any quantity and quality can be bought at low price in villages. Remote villages situated in the interiors of the country have no organized system of milk collection. Khoa produced in small villages have to travel a long distances to find a market. Contamination and temperature variation cause rapid spoilage thus tremendous scope exists for making Khoa powder from surplus milk. The manufacture of Khoa powder is a good possibility for reducing the products spoilage by moisture and therefore improves the shelf life. This process guarantees a shelf life for more than eight months. The existing drawing system can be adopted for manufacturing Khoa powder in an efficient continuous and hygienic manner.

The method for production of tray dried Khoa consists of preparing it from standardized buffalo milk (5% fat and 9% SNF) heating the product at a suitable temperature to reduce moisture to about 20 percent and comminuting it to fine particles. These particles are uniformly distributed in trays in a thickness of 1 cm and dried in a cabinet drier at
about 70°C. The chemical composition of tray dried Khoa was: moisture 3.8%, fat 30.8% protein 25.7%, lactose 34.7% and ash 5.0%.

Standardized buffalo milk was first heated to a pre-determined temperature in a stainless steel double-jacketed vessel to develop a cooked flavor. The heated milk was pumped to a milk distribution channel of the roller drier at a pre-determined flow rate and steam pressure at 65 + 5 psi. Khoa powder formed in thin sheets was scraped, ground, sieved and packed. The chemical composition of Khoa powder was : moisture 3.5%, fat 32.2%, protein 25.7%, lactose 33% and ash 5%.

The manufacture of Khoa powder by spray drying technique was standardized for large-scale operations. Buffalo milk was vacuum evaporated to 35% TS, heated to develop cooked flavor and later spray dried at an inlet air temperature of 1900°C and outlet air temperature of 88°C. The average chemical composition of Khoa powder from the spray process was: moisture 2.5%, fat 33.2% and ash 4.9%.

Khoa powder form tray, roller and spray processes could be preserved in tin containers at seven months, respectively. Storage of product at 5°C extended the shelf –life to seven, eight and nine months respectively.

Khoa is used for preparation of various edibles such as burfi, peda, Kalakand, gulabjamun etc. and is also used in same proportion for making rabri, vegetarian dishes etc.

On the basis of the above background the present work has been conducted on the following lines-
1. **Introduction** –

This section deals with the introduction of the Khoa industry, its constituents, chemical composition, form and different cites of India. Its microbial count, shelf life and innovative systems of making Khoa and Khoa powder.

2. **Materials and Methods** –

In this section material and methods used for experimentation work has been given out. Which includes the experiments listed above the methods for chemical, biochemical and microbial estimation have been given.

3. **Review of Literature** –

This section deals with the review of literature present in various journals and books on the subject with the special reference to the work done by the previous researchers.

4. **Observations** –

In this section observations recorded on the following studies have been given. The results obtained are given in the various Tables-

1 **Studies on the physical parameters** –

In this chapter the physical parameters of Khoa available in the market has been worked out. Data’s have been obtained on the colors; texture, consistency, firmness, smell, taste and hedonics have been
given. The characters of Danedar variety and Pindi variety have been worked out.

2 Biochemical Parameters –

In this chapter studies on the biochemical parameters have been worked out, in which estimation on the minerals components present in two varieties of Khoa have been done. Data's related to ash, calcium, magnesium, phosphorous, citrate, sodium, potassium, chloride, copper, and iron have been analyzed.

The vitamins present in milk and Khoa have been worked out by special reference to the estimation of the water-soluble vitamins. Data's have been obtained on Thiamine, Riboflavin, Vitamin B₆, Folic acid and Vitamin C was analyzed. Both Danedar and Pindi variety was subjected to biochemical analysis so that loss of vitamins in making Khoa could be estimated.

The various biochemical groups of organisms present in the two varieties of Khoa have been estimated. Data's have been obtained on the total count, acid producers, proteolytic, chromogenic, thermophilic, lypolytic, spore forming, moulds colony forms and enterococcus group of organisms.

3 Studies on the Microbial Parameters –

In this study quantitative estimation of microbial organisms have been estimated with reference to bacteria, yeast and moulds count and Coliform count present in Khoa during storage has been worked out on both the varieties of Khoa.
In the next phase quantitative estimation of different types of yeast and moulds have been worked out. Data's have been obtained on the number of individual organisms and their percentage occurrence in both Pindi and Danedar variety. Emphasis have also been given on the effect of sugar on these organisms.

During the isolation programme bacterial organisms were collected with their isolate numbers. These were identified on the basis of morphological and biochemical characters. The morphological characters taken into consideration were Gram reaction, shape of organisms, motility and spore formation.

Biochemical parameters used for identification of organisms were test for lactose fermentation, catalase activity, gas formation, Vogus Paursker, citrate, indole, oxidase, H$_2$S test and DNAase test. The results obtained from the following characters, bacterial organism was identified. Quantitative estimations of bacterial organisms were also estimated together staphylococcal count in the two varieties of Khoa. Their number of individuals and percentage occurrence has also been worked out.

4 Studies on the Keeping Quality of Khoa –

In this chapter studies related to the exploration of bacterial organisms and staphylococcal counts during storage have been worked out. The staphylococcal counts were estimated at three different moisture levels during storage upto 48 hrs at 35 and 5°C.
Experiments were conducted on the bacterial and moulds counts at 37, 30, 22 and 5 to 7°C temperature after 2, 4 and 8 days respectively. Both Pindi and Danedar variety of Khoa were considered for the above studies.

Variations in the chemical properties after 3, 6, 21 and 30 days at 5°C has worked out for Data’s related to pH, dry matter, moisture, protein, fat and ash percentage. Both Danedar and Pindi varieties were subjected to these studies.

5 Control Measures –

In this chapter attempts were made to control the microbial flora during the storage of Khoa. Attempts were made to control the flora by adding sugar in 30, 40 and 50% concentration. The number of organisms was studied after 3, 6, 9 and 12 days respectively.

Attempts were made to preserve Khoa for long duration using various anti fungal substances were used and in their presence yeast and moulds count were studied at 30°C temperature after 2, 4, 6, 8, 10, 12 and 21 days. At the same time its effect during storage at 5°C was also studied after 7, 14, 21 and 28 days.

From the above experiment the promising antifungal substance was selected and their effect on chemical constituents of Khoa was studied after 1, 7, 14 and 21 days on pH, dry matter, moisture content, fat, protein and ash percentage.

Antibiotic substances were also screened against bacterial organisms so that better antibiotic could be selected for its using
during storage. For these study seven antibiotics was screened against six bacterial organisms isolated.

In the next stage MIC concentration of the effective antibiotic were worked out so that its minimum growth of inhibition could be obtained. After the above studies effective antifungal and antimicrobial substances were obtained and their combination can be used to increase the shelf life of Khoa both at the low temperature and at the room temperature.

5 Results and Discussion –

In this section the results obtained during the study period will be discussed with reference to the results obtained by others workers.

6 Summary and Conclusion –

This section deals with the summary of the work done and the conclusions drawn on the basis of the present work has been underlined.

7 Bibliography