COURSE TITLE: MICROBIOLOGY OF MILK PRODUCT

COURSE NO. - DTM-222: CREDIT HRS - 2 (1+1)

MICROBIOLOGY OF THE INDIGENOUS MILK PRODUCTS

Desiccated Milk Based Products

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INDIGENOUS MILK PRODUCTS

- The term ‘indigenous milk products’ refers exclusively to dairy products of a particular region or country
- 47% of total milk products in India is converted to various indigenous products
- These products are the backbone of the Indian confectionary

In India, about 50% of the total milk produced is converted into various traditional milk products. These products account for 95% of all the milk products consumed and it is worth noting that the organized dairy industry handles only about 17 - 18% of the total milk produced in the country. Rest of the milk is used by small scale sweet meat shops (Halwaies) in unorganized manner.

Traditional Indian dairy products can be classified into six categories based on the principle of manufacture

- Heat desiccated products
- Heat and acid coagulated products
- Fermented products
- Products made with addition of cereals
- Clarified butter fat (ghee)
- Frozen products

Indian dairy industry

At A Glance

June 19, 2019

Indian Dairy Industry	₹5,67,000 crore
Organised Dairy Industry	₹100,000 crore
Year-On-Year Growth	10%
Value Added Dairy Products	₹25,000 crore
Paneer	₹10,000 crore
Cheese	₹3,500 crore
Flavoured Milk	₹2,000 crore
Milkshake	₹500 crore

https://www.businesstoday.in

Chhanna are curds or cheese curds, originating from the Indian subcontinent, made from buffalo or regular cow milk by adding food acids such as lemon juice instead of rennet and straining. It is very similar or analogous to cottage cheese.

Paneer is a fresh cheese common in the Indian subcontinent. It is an unaged, non-melting soft cheese made by curdling milk with a fruit- or vegetable-derived acid, such as lemon juice. Its acid-set form, before pressing, is called chhana.

Kalakand is an Indian sweet made out of solidified, sweetened milk and paneer. It is also popular in Pakistan

Rasogulla is an Indian syrupy dessert popular in the Indian subcontinent and regions with South Asian diaspora. It is made from ball-shaped dumplings of chhanna and semolina dough, cooked in light syrup made of sugar. This is done until the syrup permeates the dumplings.

Shrikhand is an Indian sweet dish made of strained dahi.

Rabri is a sweet, condensed-milk-based dish, originating from the Indian subcontinent, made by boiling milk on low heat for a long time until it becomes dense and changes its colour to off-white or pale yellow. Jaggery, spices, and nuts are added to it to give it flavor. It is chilled and served as dessert.

Peda or Pera is a sweet dish hailing from the Indian subcontinent. Usually prepared in thick, semi-soft pieces, its main ingredients are khoa, sugar and traditional flavorings including cardamom seeds, pistachio nuts and saffron.

Kheer is a type of pudding from the Indian subcontinent, made by boiling milk and sugar with one of the following: rice, broken wheat, tapioca, vermicelli, or sweet corn. It is flavoured with cardamom, raisins, saffron, cashews, pistachios, almonds or other dry fruits and nuts.

Rasmalai or rossomalai is a dessert originating from the eastern regions of the Indian subcontinent. The name rasmalai is the Hindi cognate of Bengali: rosh, meaning "juice", and molai, meaning "cream". It has been described as "a rich cheesecake without a crust

Dahi is a traditional yogurt or fermented milk product, originating from the Indian subcontinent, usually prepared from cow's milk, and sometimes buffalo milk, or goat milk. It is popular throughout the Indian subcontinent.

Kulfi or Qulfi is a frozen dairy dessert originating in the Indian subcontinent in the 16th century. It is often described as "traditional Indian ice cream".

Lassi is a popular traditional dahi-based drink that originated in the Indian subcontinent. Lassi is a blend of yoghurt, water, spices and sometimes fruit. Sweet and mango lassis are just like milkshakes. Bhang lassi is infused with the drug cannabis in the form of bhang.

Gulab jamun is a milk-solid-based sweet from the Indian subcontinent, popular in India, Nepal, Pakistan, the Maldives, and Bangladesh, as well as Myanmar.

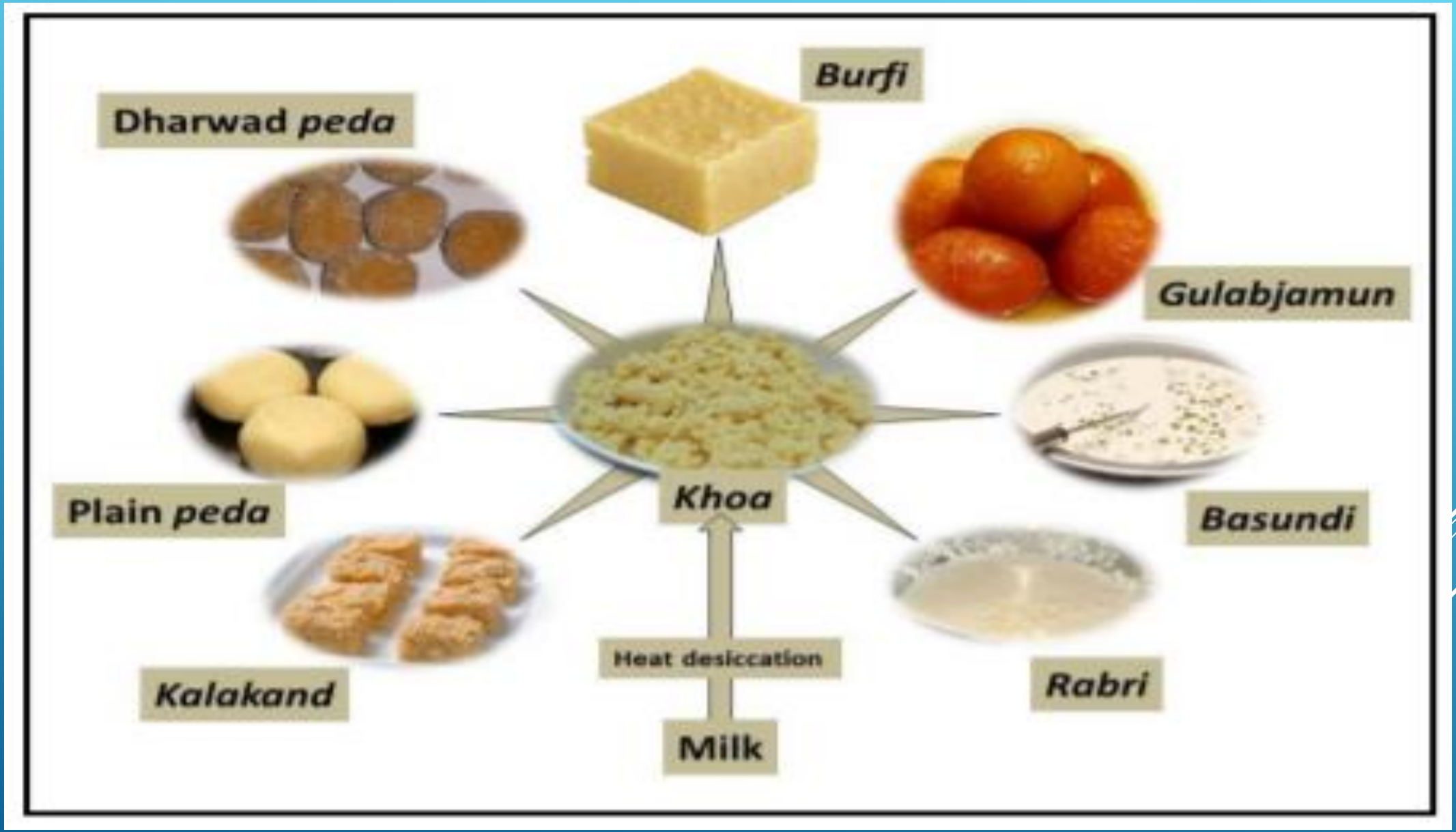
Barfi, borfi or burfi is a dense milk-based sweet from the Indian subcontinent, and a type of mithai. The name is a derivative of the Persian word barf, which means snow. A few of the famous varieties of barfi include besan barfi, kaaju barfi and pista barfi.

Sandesh is a dessert, originating from the Bengal region in the eastern part of the Indian subcontinent, created with milk and sugar. Some recipes of Sandesh call for the use of chhanna or paneer instead of milk itself.

DESICCATED MILK –BASED PRODUCTS

- Dehydrated or concentrated milk products
- Gulabjamun
- Peda
- Rabri
- Kulfi

Variety of heat desiccated (khoa-based) sweets of Indian sub-continent



Gross composition (%) of some heat desiccated traditional milk products

Product	Milk source	Moisture	Fat	Protein	Lactose	Sucrose	Ash
Khoa	Cow	30.4	22.2	18.8	24.9	-	3.7
	Buffalo	32.0	24.2	18.3	22.0	-	3.5
Rabri	Buffalo	49.8	15.5	9.5	11.3	12.0	2.0
Khurchan	Buffalo	27.9	23.6	15.4	14.9	15.2	3
Basundi	Cow	52.5	10.6	7.8	10.8	15.9	1.4
	Buffalo	52.9	11.4	10.1	11.1	12.5	1.8
Peda	Buffalo	14.4	19.3	15.3	15.2	33.3	2.5
Milk cake	Buffalo	16.8	21.3	11.4	7.7	40.5	2.3

Prasad Rasane*, Beenu Tanwar, and Anirban Dey
September - October 2015 RJPBCS 6(5) Page No. 39.

BIS* standards for three khoa varieties

Khoa type	Total solids, minimum (%)	Fat in dry matter, minimum (%)	Ash in dry matter, maximum (%)	Titratable acidity, (% lactic acid in mass), maximum
Dhap	55	37	6	0.6
Pindi	65	37	6	0.8
Danedar	60	37	6	0.9

Source: Aneja et al. (2002)
*BIS: Bureau of Indian Standards

GULABJAMUN

- Popular khoa-based sweet

- Composition:

Fat	10%
Protein	6%
Sugar	42%
Acidity	0.6%

Production of Gulab Jamun from khoa

Khoa

↓

Planetary mixer ← Maida & other ingredients

↓

Dough

↓

Portioning machine (8g each portion)

↓

Ball forming machine

↓

Deep fat frying tank (140°C)

↓

Sugar syrup tank

↓

Gulabjamun

↓

Packaging

↓

Storage

Factors affecting the microbiological quality of gulabjamun:

- Quality of khoa
- Quality of floor and water
- Quality of sugar
- Quality of nuts
- Contamination from utensils and soil
- Packaging

Defects of gulabjamun:

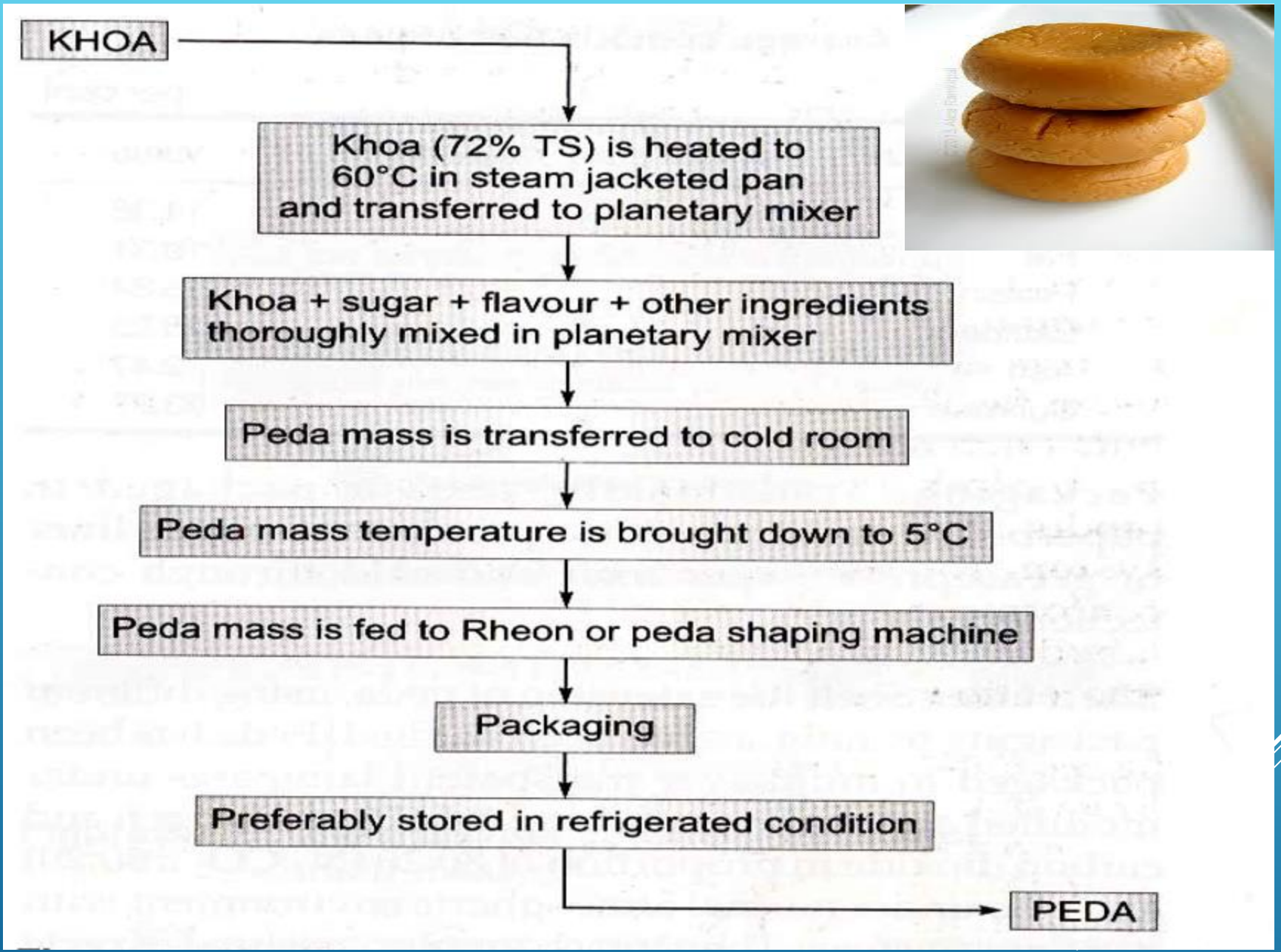
- Stale and sour flavour

PEDA

- **It is the sandesh of north**

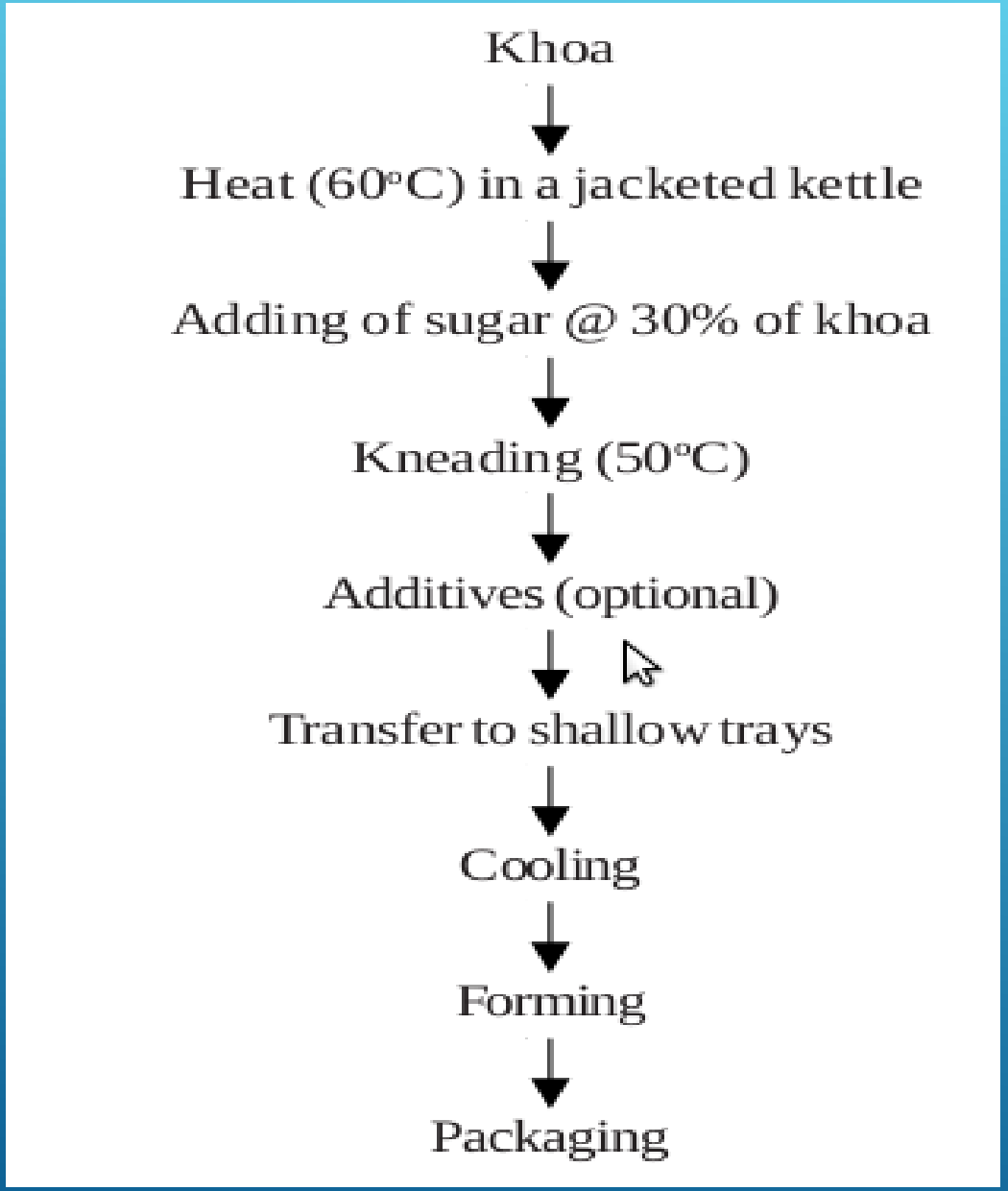
Composition:

Moisture	**14%**
Fat	**19%**
Protein	**15%**



Production of Peda from khoa

Production of Barfi from khoa



Constituents (%)	Laboratory prepared samples (Average)	Market samples (Range)
Moisture	15.67	4.3 – 20.5
Fat	20.48	4.1 – 26.8
Proteins	14.92	1.4 – 20.3
Lactose	15.82	5.0 – 20.0
Ash	2.75	1.6 – 3.2
Sucrose	30.36	16.7 – 59.7

Characteristics	Requirements	
	Mawa burfi	Other Type
Moisture, per cent by wt., Max.	15.0	15.0
Milk fat, per cent by wt., Min.	12.5	10.0
Lactose, per cent by wt., Min.	15.0	12.0
Sucrose, per cent by wt., Max.	48.0	40.0
Acidity, per cent (as LA), Max.	0.35	0.45
Standard plate count/g, Max.	30000	30000
Yeast and moulds count/g, Max.	10	10

Typical microflora of market khoa based sweets

Group	Genera
Yeasts	*Saccharomyces, Candida, Rhodotorula, Aspergillus, Geotricum, Mucor, Syncephalostrum, Fusarium, Rhizopus, Cladosporium*
Bacteria	*Streptococci, Micrococci, Bacillus*
Pathogenic bacteria	*Staphylococci*

MICROBIOLOGICAL QUALITY OF PEDA

- Microbial number
- Microbial types
- Quality of milk
- Production hygiene
- Contamination from utensils
- Soil contamination
- Unclean handlers

- ✓ Khoa serves as a favorable medium for the growth of a variety of contaminating microorganisms due to its high moisture content and high nutritive value.
- ✓ The market khoa can be kept in good condition for 48 h under normal conditions and thereafter deteriorates due to microbial action.
- ✓ These organisms gain access as contaminants from different sources in to product.
- ✓ The rapid spoilage of khoa is due to contamination with molds from different sources.
- ✓ A number of research work were carried out to know the microbiological status of khoa and khoa based sweets in different parts of the country.

DEFECTS

- Rancidity
- Sour flavour
- Mold growth
- Shelf-life: Samples with MAP (modified atmosphere packaging) increase shelf-life of 15 days at 37˚C and at 20˚C increase to 30 days.

Mould growth --- Storage of Khoa at ambient and also at lower temperatures favours the growth of molds which impart off-flavours and also produce certain mycotoxins under favourable conditions. High no. of mold growth observed due to high moisture content in the product, air leakage in the packed product, high humidity and aeration in storage room etc.

Control measures

Since molds usually enter the product through aerial contamination, proper sanitation through cleaning and fumigation of the dairy environment would control the problem. Apart from this, mold contamination in the product can also be tackled through control of humidity and aeration in the processing and packaging room.

- The moisture level in *khoa* should not be allowed to exceed the prescribed limits.

- *Khoa* should be stored in air-tight packages.

- Treatment of wrapping paper with antifungal agents like potassium sorbate controls mold growth. However, use of such chemicals in the product is not permissible.

Types of micro flora in khoa and khoa based products

- Various groups of bacteria (acid producers, proteolytic, chromogenic, lipolytic, aerobic sporeformers, psychrotrophs, thermophiles, pathogens), yeasts and moulds have been reported to occur in khoa.

- Psychrotrophic bacteria mainly Pseudomonas, Achromobacter, Flavobacterium and Alcaligenes have been isolated from peda.

- On the basis of comparative analysis of khoa, burfi and peda, khoa contained higher population of yeasts and moulds than burfi or peda.

- The composite microflora of market burfi and peda was studied in which bacteria, yeasts and moulds were isolated from both the products, though the proportion of yeasts and moulds was extremely low as compared to bacteria. Among the bacteria, Gram-positive (mainly cocci) predominated in both the products.

Microbiology of khoa:

Khoa is a favourable medium for the growth of microbes on account of its nutritive value and moisture content. The unsatisfactory practices generally followed in its production, handling and storage in unorganized sector results in poor shelf life. Although during manufacture of khoa, milk is subjected to drastic heat treatment, the aerobic spore formers are known to survive such heat treatment and may outnumber other types of micro-organisms, thereby suggesting that the survivors might multiply during subsequent storage. The possibility of contaminants gaining entry into these products during subsequent handling also cannot be ruled out.

A number of research studies showed the effect of antifungal agents on keeping quality of khoa. They treated the samples with natamycin (0.5%) and potassium sorbate (0.3%). It showed lower yeast and molds counts during storage at 30°C and also at 5°C.

Chavan & Kulkarni (2006) made efforts to improve the microbiological quality of khoa by solar radiation and microwave heating. The application of microwave heating was observed to be quite superior in reducing the total bacterial count, yeast and mold count (YMC) and spore count. It also showed very slow rate of increase during storage for a week. Use of solar radiation through convex lens showed promising results in reducing microbial counts and particularly more effectively on YMC.

A study was conducted to analyze bacterial contaminants / pathogens in khoa samples sold in Madhya Pradesh in India. A total of 50 samples of khoa were brought from different localities of Madhya Pradesh at random. Bacterial colony counts were also performed on these samples. Staphylococcus and Streptococcus species were the predominant isolates. The viable counts obtained ranged from 1.3x104 to 2.1x106 cfu/g. Contamination of khoa by pathogenic bacteria could be an important factor of gastrointestinal infections including food poisoning and food borne illness.

Heat processing of milk having 3.5 - 6.5% fat at either 63℃ or 73℃ eliminated all *Escherichia coli*. Under similar processing conditions, Potassium sorbate (3000 ppm) appeared more effective in inhibiting the growth of selected yeast and molds in khoa at 7℃ compared to ascorbic acid (3000 ppm). Reducing the water activity (aw) of khoa from 0.97 to 0.93 did not appear to enhance the preservative effect. The reduction of *E.coli* or *Staphylococcus aureus* in khoa during prolonged storage at 6–7℃ was less than one log cycle, regardless of aw or preservative type. Survival of *Staphylococcus aureus* in khoa appeared to be enhanced with a decrease in aw (Sohal et al. 1993). A study was conducted to identify the incidence of different microorganisms in air and khoa samples collected from different sections of a khoa plant. *Penicillium citrinum* was found to be predominantly present in both air (24%) and khoa samples (27%). The other molds encountered were *Geotricum candidum*, *Mucor racemosus*, *Aspergillus niger*, *Syncephalastrum oxysporum*, *Rhizopus stolonifer*, *Cladosporium cladosporioides*, *Absidia corymbifera* and *Pacilomyces variotti* (Rajarajan et al. 2007).

Pathogenic organisms from khoa, burfi and peda

A number of pathogens like *Salmonella typhi*, *Shigella dysenteriae*, *Vibrio cholerae* and *E. coli* are able to survive for long periods during storage of khoa. Subsequently, a number of related studies have revealed the occurrence of staphylococci, especially those of heat stable, coagulase positive, enterotoxin producing types in khoa, burfi and peda. Drug resistant coliforms and enteropathogenic *E. coli* have also been isolated from khoa. Although coliforms are heat labile, their isolation from large samples of the product indicates post-processing contamination. The presence of coliforms may also indicate the likely presence of potential pathogens like Salmonella, Shigella etc. in the product. Contamination of khoa, peda and burfi with *Salmonella schottmuelleri* and *Shigella flexneri* has also been found to correlate with faecal contamination. It was proved that *S. aureus* a potent food poisoning organism, can multiply in khoa, peda and burfi at the ambient storage temperature as well as at 37ºC.

THANK YOU