

Physicochemical Hazard Analysis of Milk and Khoa in Manual and Mechanical Production Processes in Parbhani City of Maharashtra State of India

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ABSTRACT

The present study was aimed for physicochemical hazard analysis of Khoa production practices in and around Parbhani city of Maharashtra State, India. A total of six commercial Khoa production units consisting three each manual and mechanical methods were used during present experimentation. The collected samples were evaluated for adulteration and physicochemical of raw milk used for Khoa production in addition to identified CCP'S of production process was carried out. A total 24 samples were collected from each of units, 09 critical control points from each method were selected and 08 replicates were taken for hazard analysis. In present experiment, all raw milk samples were found to be negative for starch, urea, caustic soda and sodium chloride adulteration. Physicochemical analysis of raw milk samples was performed by using Cot on boiling and Alcohol test in manual Khoa production units. The result revealed that 8.3% samples was positive for Clot on boiling test and 25.00% for Alcohol test in manual, as against all samples were negative for mechanical Khoa production units for same. The Physicochemical quality assessment of raw milk used for Khoa production was done with the help of pH, titratable acidity, specific gravity and fat. The pH, titratable acidity and fat of raw milk did not differ significantly amongst manual and mechanical method. Whereas, specific gravity of raw milk were significantly differ ($p < 0.001$) amongst manual and mechanical method. The physical quality assessment of Khoa revealed that whitish with tinge of brown colour was found in all samples (100%) prepared by manual method and 58.33% by mechanical method. The rich and nutty odour was noted in 83.33% samples of Khoa prepared by both the methods. The flavour of Khoa was observed as slightly sweet in 100.00 and 58.33% samples in manual and mechanical method, respectively. The smooth and granular texture of Khoa was observed in 100% manual method samples and 58.33% in mechanical method. The chemical quality assessment of Khoa in relation to moisture and titratable acidity revealed that a highly significant ($p < 0.01$) difference was seen in both the parameter among both the methods.

Key words: Khoa, Milk, Titratable acidity, Parbhani city

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INTRODUCTION

India ranks 1st in respect of buffalo and second in cattle in the world. India has 57% of buffalo world population. India possesses 27 acknowledged indigenous breeds of cattle and 7 breeds of buffaloes. Indian milk production has been rising constantly it produces 146.31 million tonnes of milk 50 % more than U.S. and 3 times more than China, during last 15 years milk co-operatives have converted about 20% of milk procured in to traditional value added products. Dairy sector provides livelihood and security net to the landless and marginal farmers. About 7 crore rural household are engaged in dairying with 80% of cow population. The share of value added product is estimated to increase to 30% by 2021, 2022. The government of India targeted doubling the farmer's income by 2022 through dairy by raising milk production. India is the largest producer of the milk in the world since 15 years. The milk yield was 17 to 22 million tonnes in 1960 has increased to 163.7 million tonnes in 2016-2017. The annual growth rate of Indian milk production is 5.53% and global was 2.09%¹.

Amongst various traditional products Khoa is heat coagulated partially dehydrated milk product it is obtained by heat desiccation of whole milk to 65-70% milk solids without addition of any foreign ingredients. Khoa is a rich source of energy, about 458 kcal/100gm of products. It contains large quality of building muscle building proteins, bone forming minerals and energy giving fat and lactose. It forms an important base for preparation of milk sweets which are an integral part of Indian food heritage. The Khoa and Khoa based sweets have high commercial significance. The Khoa is produced by traditional Indian method in which milk is heated in an open pan over non smoky fire and continuously stirred and scraped with the help of scrapper to avoid scorching of milk solids sticking to the pan. The milk is heated till it attains semi solid dough. In recent times mechanized Khoa making is done with Khoa making machine to overcome metallic contamination problems⁸.

Gupta and Gupta⁷ reported that physical qualities of milk like colour, body texture, flavor and chemical qualities like moisture and total solid percentage affect yield and quality of Khoa. Wanjari *et al.*¹⁸ reported that adulteration of milk in India is about 10% of total trade this as public health significance.

Implementation of FSSAI rules and regulations as per Food Safety Standard Act, 2006 for Khoa production is a challenging task from the public health point of view. The most of the Khoa production business is being done in traditional way with the help of available local resources. In recent times, due to high urbanization the demand for Khoa increased resulting into use of mechanized processing for Khoa production. Little information is available about scientific evaluation of Khoa production processes in unorganized sector.

The present study was planned with objectives to study adulteration of milk used in Khoa production and physicochemical assessment of Khoa in manual and mechanical khoa production processes in unorganized sector.

MATERIAL AND METHODS

Selection of Khoa production unit

A total of 3 Khoa production unit using manual method and 3 using mechanical method were randomly selected from in and around Parbhani city.

Collection of samples

Samples consisting of raw milk and khoa were collected using standard procedures and protocols.

Adulteration analysis of Milk

The milk samples were analysed for adulteration in relation to Starch, urea, caustic soda, and sodium chloride as per procedure and protocols prescribed by FSSAI⁴.

Physico-Chemical analysis of milk

Clot on boiling

The clot on boiling test was performed as per the method described by O connor (1995).

Alcohol test

The alcohol test was performed as per the method described by Tassew and Seifu¹⁷.

Specific gravity

Specific gravity of milk sample was estimated as per the method described by Gemechu *et.al*⁵.

pH

The pH of the milk samples was reported based on the method described by O connor¹⁰.

Titrateable acidity

Titrateable acidity of milk sample was determined as according to the method of Association of Official Analytical Chemists².

Determination of Milk Fat

Determination of milk fat is by method prescribed in manual of FSSAI⁴.

Physical analysis of Khoa

Methods prescribed by De S, (1991) were used for physical analysis of Khoa in relation to colour, appearance, odour, flavour, texture and consistency.

Chemical analysis of Khoa**Determination of moisture**

Moisture content was determined according to method recommended by FSSAI⁴.

Determination of Titrateable Acidity

Titrateable acidity was determined as per the method used by Rudreshappa and De¹⁵.

Statistical analysis

A total of 8 replicates of each of 3 units of Khoa production by manual and mechanical methods were used for recording of observation.

The raw milk samples were analysed for adulteration, physico-chemical and microbial analysis. The percentage of adulteration and qualitative physico-chemical analysis were estimated. The mean values of quantitative physico-chemical and microbial values of raw milk samples were compared between groups.

The percentages of qualitative physical analysis were recorded. The mean quantitative chemical analysis of Khoa in relation to moisture and titrateable acidity were compared between groups.

The Analysis of Variance (ANOVA) was followed by comparison of means between treatment groups using SYSTAT® software.

RESULTS AND DISCUSSION**Adulteration analysis of milk**

Milk and milk products are proven to various health hazards due to probability of contamination, unhygienic conditions, improper handling and storage. In Indian, Khoa is used for preparation of various sweets, vegetable curries etc. Quality of raw milk determines Khoa quality, in dairy sectors particularly unorganized sector adulteration is dampened resulting in to major health risk for consumer. Various adulterants give like starch, urea, caustic soda, sodium chloride etc⁶.

The Food Safety and Standards Act prescribes milk standards for various standard and designation for raw milk. The buffalo milk which is raw should have 5 to 6% fat and 9% SNF whereas; raw cow milk should have 3 to 4% and 8.5 % SNF. Adulteration of raw milk is an important issue begins addressed by FSSAI also. While common adulterants like water, starch, sugar etc. can be tested for any laboratory, other adulterants required for food adulteration standards.

In present study it was observed that the Khoa production units used whole cow and buffalo raw milk only. All 48 raw milk samples collected from manual (24) and mechanical (24) were tested for adulteration for starch, urea, caustic soda and sodium chloride. All 48 samples were found to be negative for presence of any adulterants. The results are given in Table 1.

Table 1: Adulteration analysis of raw milk samples used for Khoa production

Sr. No.	Adulterants tested	Khoa Production process	
		Manual (N=24)	Mechanical (N=24)
1	Starch	Negative	Negative
2	Urea	Negative	Negative
3	Sodium chloride	Negative	Negative
4	Caustic soda	Negative	Negative

Physicochemical analysis of milk

In order to make good dairy product, good product of raw milk essential. In India milk is supplied for unorganized sectors exposing it for various hazards. Physico-chemical analysis of raw milk gives idea of its quality¹⁴.

Qualitative physico-chemical analysis of raw milk

The platform tests are used as preliminary screening test for qualitative physico-chemical analysis of raw milk. Clot on Boiling and Alcohol tests are routinely used test for acceptance or rejection of milk for further

processing¹⁵. In present study all 48 raw milk samples screened by COB and Alcohol test. All 24 raw milk samples used in mechanical Khoa production unit were found to be negative by COB test whereas, about 8.30% raw milk samples were positive in manual Khoa processing unit. The alcohol test detected 25% raw milk samples unfit for further production in manual unit whereas, all 24 samples of mechanical unit negative for alcohol test. The results are given in Table 2. The screening of raw milk by platform test is help in implementation of HACCP plan.

Table 2: Qualitative Physico-chemical analysis of raw milk used for Khoa production

Sr. No.	Test	Khoa Production process* (percent positive)	
		Manual (n=24)	Mechanical (n=24)
1	Clot on Boiling	8.30	Negative
2	Alcohol test	25.00	Negative

Quantitative physico-chemical analysis of raw milk

Assessment of quantitative physico-chemical analysis of raw milk at various stages of production process was help in critical evaluation of hazards¹¹. Food and Safety Standard Act (2006) also stipulates quality parameters of raw milk in present study were pH, Titratable acidity, specific gravity and fat. The results are given in Table 3. The average pH, Titratable acidity, specific gravity and fat of raw milk used in manual Khoa production

processes were 6.70 ± 0.01 , 0.15 ± 0.00 , 1.031 ± 0.00 , and 4.62 ± 0.02 respectively. The values recorded in raw milk used for mechanical Khoa production process were 6.66 ± 0.01 , 0.14 ± 0.00 , 1.20 ± 0.00 , 4.67 ± 0.21 respectively.

The physico-chemical analysis of raw milk is used at both manual and mechanical Khoa production units revealed that the milk used for processing was as per FSSAI standards and fit for further processing.

Table 3: Quantitative Physico-chemical analysis of raw milk used for Khoa production

Sr. no	Parameter	Khoa Production process (Mean \pm S.E.)	
		Manual (n=24)	Mechanical (n=24)
1	pH	6.70 ± 0.01	6.66 ± 0.01
2	Titratable acidity	0.15 ± 0.00	0.14 ± 0.00
3	Specific gravity	1.031 ± 0.00	1.02 ± 0.00
4	Fat	4.62 ± 0.02	4.67 ± 0.21

Physico-Chemical analysis of Khoa

Qualitative physical analysis of Khoa

By considering nutritional significance and economical importance of Khoa, it becomes essential to chemical sensory and organoleptic qualities of Khoa. The colour, appearance,

odour, flavor, texture and consistency are important quality parameters of Khoa⁹. The good quality Khoa requires whitish colour with brown tinge, slightly oily appearance, rich and nutty smell, sweetish flavour and granular consistency¹⁶.

The results of qualitative physical analysis of Khoa produced in both types of units are given in Table 4. In manual method all the samples (100%) showed whitish colour with brown tinge where as 58.33% samples from mechanical method showed the same. The percentage of appearance of Khoa was oily in 100% Khoa samples from manual method and 58.33% in mechanical method. The rich and nutty odour seen in 83.33% Khoa samples from both the production processes. All the 100% samples showed slightly sweet flavour in manual method where as 58.33% shows in mechanical method. The texture and

consistency of Khoa was smooth and granular in 100% samples produced by manual method whereas, the same was 58.33% in mechanical method. It is interesting to note that all 100% samples of Khoa prepared by manual method showed better organoleptic qualities than mechanical method. Rajorhia and Srinivasan¹² while studying manual and mechanical method of Khoa production technology also reported superiority of manual method over mechanical method. In relation to organoleptic qualities the observations in present study were on similar lines. The results are given in Table 4.

Table 4: Qualitative physical analysis of Khoa

Sr. no.	Parameters	Type	Khoa Production process (% positive)	
			Manual (n=24)	Mechanical (n=24)
1	Colour	Whitish with tinge of brown	100.00	58.33
2	Appearance	Slightly oily surface	100.00	58.33
3	Odour	Rich and Nutty	83.33	83.33
4	Flavour	Slightly sweet	100.00	58.33
5	Texture and consistency	Smooth ,granular	100.00	58.33

Qualitative chemical analysis of Khoa

Khoa is a concentrated milk product which is very rich in total solid. The FSSAI has recently revised standards for milk and milk products to widen the scope of existing standards in food products standard and Food Additives Regulation, 2011. In the amendments has been made in the year 2018. The standards stipulates products shall come from total solids of minimum 55%, milk fat minimum 30%, total ash maximum 6% and titratable acidity 0.9%.

The mean manual Khoa production produce Khoa with $27.77 \pm 0.48\%$ moisture whereas, the mechanical method produced Khoa with $37.50 \pm 1.13\%$ moisture. A significantly higher ($p < 0.01$) moisture was observed in Khoa produced by mechanical methods. The manual method of Khoa

production utilizes large energy from wood, cattle dung, kerosene used in open chullha. It involves intensive heating with an aim of evaporating large quantity of water in the milk. In mechanical method of Khoa production the heat application is controlled by using gas. There by resulting in to gradual loss of moisture. This result in to retention of higher moisture in Khoa produced by mechanical method⁸. The similar results also present in present study.

The quality standards of Khoa as per FSSAI Standards, 2018 requires total solid of 55% in Khoa. Earlier Wanjari *et al.*¹⁸ reported moisture percentages of 28.65 to 30.98 in Khoa. The results of present study are on similar lines.

Titratable acidity gives an idea of quality of Khoa upon storage. The titratable

acidity observed in manual method was 0.69 ± 0.01 and in mechanical method was 0.75 ± 0.01 . The comparison of mean showed higher significant ($p < 0.01$) titratable acidity in Khoa produced by mechanical method than manual method. Khoa being a nutritious substance and moisture might have resulted in to higher acidity in comparatively high moisture contain

Khoa produced by mechanical method. Earlier Wanjari *et al.*¹⁸ found titratable acidity of Khoa in the range of 0.59 to 0.70. The results of present study are on similar line. The titratable acidity observed in the present study in both method of Khoa production was found to be FSSAI Standards 2018. The results are given Table 5.

Table 5: Quantitative of chemical analysis of Khoa

Sr. no.	Parameters	Production type	
		Manual (n=24)	Mechanical(n=24)
1	Moisture	27.77 ± 0.48^a	37.50 ± 1.13^a
2	Titratable acidity	0.69 ± 0.01^a	0.75 ± 0.01^a

a-($p < 0.01$)

CONCLUSION

All the objectives of study were achieved. The following conclusion are drawn from the study

- 1) The milk used for Khoa production in and around Parbhani city in both manual and mechanical method was free from adulteration by starch, urea, Caustic soda and sodium chloride.
- 2) The milk used for Khoa production was of good quality upon Physico-chemical analysis.
- 3) Physico-chemical hazard analysis of manual and mechanical methods revealed superiority of mechanical methods over, manual method of Khoa production.
- 4) HACCP program requires to be implemented for hygienic Khoa production.

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