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Physico-chemical and Adulteration Profile of Dried Milk in Kashmir

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ABSTRACT

Background: Milk is a highly nutritious food that serves as an excellent growth good medium for microorganisms. Converting milk into milk powder increases its shelf life and can be stored for extended period (about 1 year) without substantial loss of quality even at ambient temperatures.

Methods: The current investigation was undertaken with the aim of evaluating the quality of milk powder in Kashmir division for characterizing its physico-chemical and adulteration profile. Since all the dried milk is imported in the valley, it is important to ascertain its quality. For this purpose, whole valley was divided into three zones namely north, south and central. The physiochemical properties and adulteration profile of all the milk powder samples, collected from three zones (north, center, south) were determined.

Result: The physiochemical properties of all the milk powder samples were to be of approved quality, irrespective of the brand and class. Adulteration profile of milk powder was seen to match completely to the standards. Milk powder should be free from all the adulterants to ensure its safe and wholesome consumption to consumers. A very few samples were found positive to alkaline neutralizer.

Key words: Adulteration, Milk powder, Physicochemical.

INTRODUCTION

Milk is a highly nutritious food that serves as an excellent growth good medium for microorganisms (Rajagopal *et al*., 2005). Converting milk into milk powder increases its shelf life and can be stored for extended period (about 1 year) without substantial loss of quality even at ambient temperatures. The dairy-based powders are not only used for recombination or reconstitution, but they can be exploited for their intrinsic functional properties for application as a food ingredient in several “value-added foods” such as confectionery, bakery and meat products (Sharma *et al*., 2012). Dried milk powder must exhibit high quality in sensory, nutritional and microbiological attributes at the time of purchase (Hough *et al*., 2002). The consumer uses the milk powder in hot beverages, frozen desserts, cheese, yoghurt, bakery products, soaps and baby food items (Liod *et al*., 2005).

The milk powders are produced with legal specifications for maximum moisture content; if moisture content of milk powder is high, favors non enzymatic browning occurs. If moisture content is low, it can result in an increased fat oxidation rate (Labuza, 1971). Moreover, milk powders are frequently used for convenience during transportation, handling, processing and product formulations but they are highly susceptible to various changes such as moisture uptake, softening, browning, compaction and collapse or caking. The basic quality indicators of milk powders are both their chemical composition and their physical properties like particle size, density, flowability, solubility, water activity, *etc*. (Sharma *et al*., 2012). Milk powder manufacturers use worldwide many resources to ensure products with good sensory quality and to be having longer shelf life. Skim milk powder can have a maximum shelf life of about three years, while whole milk powder can have a maximum shelf life of six months which could be extendable to one year in presence of packaging under inert gas like nitrogen. It helps in reducing cost of transportation and storage. It mitigates, to a remarkable extent, the regional and seasonal imbalances, thereby help providing this extremely salubrious food to the regions which are deficient in milk. It serves as an excellent tool for the fortification of the staple food, there by helping in eliminating the problems arising out of nutritional deficiencies. Also, dried milk should be free from various adulterants to ensure the safe and wholesome consumption to the consumers.

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MATERIALS AND METHODS

Collection of samples

To investigate the quality of milk powder in kashmir division, Kashmir valley was divided into 3 zones, north, south and central. A minimum of ten samples of milk powder, each from SMP and WMP were collected from the market areas of each zone and evaluated for various quality characteristics.

Analysis of samples

The milk powder samples were analysed for the quality parameters given below.

Reconstitution of milk powder

10 g of skim milk or 13 g of whole milk powder was weighed, it was made up to 100 ml with warm distilled water at 24°C. Contents were stirred exactly for 90 seconds. The sample was allowed to stand until the foam settled. The period of standing after mixing did not exceed 15 minutes (FSSAI, 2012).

Physico-chemical characteristic

Moisture

Moisture of milk powder (WMP and SMP) is determined (AOAC, 2007).

Calculation-

$$\text{Dry matter per cent} = \frac{W_1 - W}{W_2 - W} \times 100$$

$$\text{Moisture per cent} = (100 - \text{Dry matter per cent})$$

Where;
W = Weight of empty dried cup (g).
W_1 = Weight of cup + sample after drying (g).
W_2 = Weight of cup + sample (g).

Fat

For the determination of fat, all the glass apparatus was rinsed by petroleum ether and dried in the oven at 102°C and after removing from the oven kept in the desiccator. 5 gram of milk powder was weighed and sample was dried and placed in the thimble. The thimble was placed in the soxhlet extractor. 15 ml of round bottom flask was taken and cleaned and filled with 90 ml petroleum ether. Whole setting was placed on a heating mantle and allowed the petroleum ether to boil. Extraction process was continued for several hours, for almost 6 hours. Condensing unit was removed from extraction unit and the sample was allowed to cool down. Finally, it removed all the lipid. Almost all the solvent was collected after distillation. The sample was placed in the oven and after removing it placed in the desiccator. Weight of the sample was taken (AOAC, 2007).

Calculation

Empty thimble= W_1.
Thimble with sample= W_2.
Weight of sample= p.
Then crude fat percentage is= $(W_2 - W_1)/p \times 100$

Titratable acidity

TA of milk powder is determined (FSSAI, 2012)

$$\%\ \text{Titratable acidity (\% lactic acid)} = 0.09 \times V$$

Where;
V = Volume of 0.1 N NaOH.
0.09= NaOH equivalent.

Insolubility index

14 g powder was reconstituted in 100 ml distilled water at 40°C. It was blended or stirred for 10s and then the mix was allowed to stand for 10 minutes. The foam was to be removed with stirring. 50 ml reconstituted milk was transferred to a centrifuge tube. The centrifuge was run at 3000 rpm for 5 minutes. Then the supernatant was decanted. The sediment was dissolved in 50 ml water and centrifuged again for 3000 rpm for 5 minutes again. Sediment obtained was expressed in ml is known as insolubility index (Abdalla *et al*., 2017).

Bulk density

A 100 ml graduated cylinder was weighed and tare weight of the cylinder was taken. A funnel with short stem was placed over the cylinder opening. Dry powder was allowed to flow freely to the funnel up to 100 ml mark. The weight of the cylinder along with the powder was recorded. The net weight of 100 ml powder was calculated and the result was expressed as g/ml (Abdalla *et al*., 2017).

Bulk density (calculations):
i. Weight of graduated cylinder (W_1) =
ii. Weight of cylinder + powder sample (W_2) =
iii. Weight of 100 ml powder (W_3) = W_2-W_1 =
iv. Bulk density = W_3/100 = g/ml

Detection of adulteration

Detergent

1 ml of suspected reconstituted milk powder sample was pipetted out into a 15 ml test tube. 1 ml of Methylene blue dye solution was added followed by addition of 2 ml chloroform. The contents were vortexed for about 15 sec and centrifuged at about 1100 rpm for 3 min. The intensity of blue colour in lower and upper layer was noted. Relatively, more intense blue colour in lower layer indicated presence of detergent in milk powder. Relatively more intense blue colour in upper layer indicated absence of detergent in milk powder (FSSAI, 2012).

Urea

This method is based on the principle that urea forms a yellow complex with p-dimethylaminobenzaldehyde in a low acidic solution at room temperature. 1 ml of reconstituted milk powder sample with 1 ml of 1.6% p-dimethyl amino benzaldehyd reagent was mixed. Distinct yellow colour was observed in milk powder containing added urea. The control (normal milk) showed a slight yellow colour due to presence of natural urea. The limit of detection of method is 0.2% (FSSAI, 2012).

Formaline

Reconstituted milk powder sample (2 ml) was taken in a test tube and 2 ml of 90 percent H_2SO_4 was added containing traces of ferric chloride from the sides of the test tube slowly. Formation of purple ring at indicated formaldehyde in milk powder (FSSAI, 2012).

Neutralizers

2 ml of reconstituted milk powder sample in a test tube was taken and 2 ml of alcoholic rosalic acid solution was added. The contents were mixed. Presence of alkali in milk powder was indicated by a rose red colour whereas pure milk showed only a brownish colour (FSSAI, 2012).

Statistical analysis

The data was processed in a computer using SPSS version 20 software package using one way ANOVA. The analysis of variance of group means was computed and significance of means tested by using least significant difference test at 5 per cent level of significance.

RESULTS AND DISCUSSSION

Physico-chemical characteristics

Physico-chemical characteristics of SMP

The data pertinent to the Physico-chemical characteristics of SMP from various zones of Kashmir division is presented in Table 1.

The fat content in samples from central, south and north zones were found to be 1.48%, 1.44% and 1.49% respectively, with an overall mean of 1.47%. There was no significant difference ($p \geq 0.05$) between the zones in terms of fat percentage as revealed by ANOVA.

The moisture percentage of samples from central, south and north zones were found to be of the value of 4.94%, 4.99% and 5.00% respectively with an overall mean of 4.97%. Moisture percentage in samples from central zone had significantly ($p \leq 0.05$) lower values compared to either north or south zones, the latter two, however did not differ significantly within themselves ($p \geq 0.05$).

Titratable acidity of central, south and north zones samples were found to be of the order of 0.17%, 0.16% and 0.15% respectively with an overall mean value of 0.16%. It would be apparent from the data presented in the table that there existed significant variation in titratable acidity scores of Skim milk powder as revealed by ANOVA in that the north zone possessed significantly lower titratable acidity as compared to central and south zones under study, the latter however did not differ significantly within themselves ($p \geq 0.05$).

Insolubility index of samples from central, south and north zones were found to be 0.30, 0.30 and 0.32 ml respectively with an overall mean of 0.30 ml. There was no significant difference between the zones in terms of insolubility index as revealed by ANOVA.

Bulk density values of the SMP samples from central, south and north zones were found to be of the order of 0.53, 0.52 and 0.53 g/ml respectively with an overall mean of 0.52 g/ml. There was again no significant difference between the zones in terms of bulk density values of the samples as revealed by ANOVA.

Physico-chemical characteristics of WMP

The data pertinent to the physico-chemical characteristics of WMP from various zones of Kashmir division is presented in Table 2.

Table 1: Physico-chemical characteristics of milk powder (SMP) collected from various zones of Kashmir division.

Parameters	Zones			Overall
	Central	South	North	mean
Fat (%)	1.48±0.003[a]	1.44±0.02[a]	1.49±0.004[a]	1.47±0.009
Moisture (%)	4.94±0.02[a]	4.99±0.006[b]	5.00±0.001[b]	4.97±0.01
Titratable acidity (%)	0.17±0.002[b]	0.16±0.002[b]	0.15±0.002[a]	0.16±0.001
Insolubility index (ml)	0.30±0.03[a]	0.30±0.01[a]	0.32±0.03[a]	0.30±0.001
Bulk density (g/ml)	0.53±0.01[a]	0.52±0.02[a]	0.53±0.01[a]	0.52±0.01

Means±SE, row wise with different superscripts, differ significantly ($p \leq 0.05$).

Table 2: Physciochemical characteristics of milk powder (WMP) collected from various zones of Kashmir division.

Parameters	Zones			Overall
	Central	South	North	mean
Fat (%)	27.40±0.10[a]	27.14±0.09[a]	27.13±0.09[a]	27.22±0.01
Moisture (%)	4.19±0.08[a]	4.85±0.07[b]	5.00±0.001[b]	4.68±0.06
Titratable acidity (%)	0.16±0.001[a]	0.15±0.003[a]	0.16±0.001[a]	0.15±0.001
Insolubility index (ml)	0.48±0.03[a]	0.49±0.01[a]	0.45±0.03[a]	0.47±0.01
Bulk density (g/ml)	0.50±0.01[a]	0.50±0.02[a]	0.47±0.01[a]	0.49±0.01

Means±SE, row wise with different superscripts, differ significantly ($p \leq 0.05$).

Fat content in central, south and north zones were found to be 27.40%, 27.14% and 27.13% respectively, with an overall mean of 27.22%. There was no significant difference between the zones in terms of fat percentage as revealed by ANOVA.

Moisture percentage of central, south and north zones were found to be 4.19%, 4.85% and 5.00% respectively, with an overall mean of 4.68%. The moisture content in central zone exhibited significantly lower ($p \leq 0.05$) values compared to north and south, the latter however did not differ significantly within themselves.

Titratable acidity of central, south and north zones were found to be 0.16%, 0.15% and 0.16% respectively, with an overall mean of 0.15%. There was no significant difference noticed between the zones in terms of titratable acidity as revealed by ANOVA.

Insolubility index of central, south and north zones were found to be 0.48, 0.49 and 0.45 ml respectively, with an overall mean of 0.47 ml. There was no significant difference between the zones in terms of insolubility index as revealed by ANOVA.

Bulk density of central, south and north zones were found to be 0.50, 0.50 and 0.47 g/ml respectively, with an overall mean of 0.49 g/ml. There was no significant difference again between the zones in terms of bulk density as revealed by ANOVA.

Adulteration profile

Samples of milk powders (SMP and WMP) were collected from the central, south and north zones. The samples were tested for usually encountered adulterants/preservatives like detergent, urea, formaline and neutralizers.

It was found from this study, that none of the samples of milk powder either SMP or WMP showed the presence of adulterants. However, some isolated samples of SMP from north zone were found to be positive for alkaline neutralizers. Despite food legislation, neutralizers such as sodium bicarbonate, sodium carbonate, sodium hydroxide and calcium hydroxide are generally used to mask the pH and acidity values of badly preserved milk, passing it off as fresh milk. These adulterants can be harmful to consumers, for example carbonates and bicarbonates can cause disruptions of hormone (Singuluri and Sukumaran, 2014).

CONCLUSION

The physiochemical properties of all the milk powder samples, collected from three zones *viz*, Central, South and North zone were in conformity with the legal standards. With respect to the physiochemical characteristics of milk powder, all the physiochemical parameters did not show any significant difference between the three zones except moisture and titratable acidity, the latter, however were within prescribed limits. Adulteration status of milk powder was seen to match completely to the required standards. None of the harmful adulterants were found in milk powder. However, some isolated samples were found positive for alkaline neutralizer, which tentamounted to almost no significance.

Conflict of interest

All authors declare that they have no conflict of interest.

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