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Full Length Research Paper

Impact of heat treatments on Sensory attributes and shelf-life of Skimmed milk

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The present study was conducted to observe the effect of various heat treatments on sensory characteristics and shelf-life of skimmed milk at the Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam, during year 2012-2013. The skimmed milk was produced from buffalo milk through cream separator and then divided into four groups viz. A, B, C and D. The group A was kept as untreated (control) and B, C, D (treated at 60 C for few s (thermization), 65 C for 30 min (pasteurization), 110 C for 10 min (sterilization), respectively. The parameters studied included; sensory attributes such as appearance/color, taste/flavor and body/texture scores and shelf-life at cold storage (6±2 C) and at room temperature. Appearance/color of pasteurized and sterilized skimmed milk was not acceptable compared to thermizide and control skimmed milk. Sterilization process improved the taste/flavor and body/texture of skimmed milk. Shelf-life of skimmed milk was remarkably (P<0.05) better with sterilization process at room temperature as well as at cold storage (6±2 C).

Key Words: Heat treatment, sensory characteristics, skimmed milk.

INTRODUCTION

Milk is a perishable and complete food, used as the primary source of nutrition for humans as well as other mammals. It is used as whole milk or as milk products including cheese, yoghurt, butter, ice cream etc. The exact components of raw milk vary by species. In addition to cattle, the milk of buffalo, goat, sheep and yak is used for the manufacture of dairy products. Historical evidence shows that the nations which used the milk and its products were found to be more civilized and capable of having sound administration (Athar et al., 2003). Skimmed milk is known as reduced fat milk obtained by skimming of milk through cream separator. The primary objective to make skimmed milk is to reduce its fat contents thus it can be easily utilized by everyone (Sangwan, 2008). Skimmed milk is used in many food products like cheese, flavored beverages, cakes and breads, etc. On various food

products, it does not impart only milky flavor, but also desirable properties to satisfy the consumer preference. Richness of skimmed milk with lactose, proteins, calcium etc, increases the nutritional value of the products. It is also an excellent alternative for those peoples who are conscious of taking fat in their diets (Mulvihill and Ennis, 2003). Heating is always employed to ensure microbio-logical safety, but in cases where milk and its products are used as food ingredients, heat treatment is employed to improve the organoleptic properties of such dairy for-mulations by manipulating the functionality of milk pro-teins (Del Angel and Dalgleish, 2006). Undesirable chan-ges in dairy products may be investigated by microbial growth and metabolism or by chemical reactions. The spoilage microbes may induces undesirable changes in the taste and odor of milk such as sour, putrid, bitter, malty, fruity, rancid and unclean. The processors preserve and process the milk by thermal processing to meet the increasing demand of milk round the year in the markets. Various thermal processing techniques are being applied in the dairy industry, carried out by subjecting milk at different temperature and time combinations in order to have a long shelf-life at room temperature (Valero et al., 2001). Sensory evaluation is regarded as a test for eva-luation as well as acceptance of milk and its products by consumers. It cannot determine the quantity of various components of the product but the products are evalua-ted through color, consistency, texture and odor etc. Thus sensory evaluation helps to provide the processors and producers with a guide to consumer acceptance for the products (Phillips et al., 1995; Saba et al., 1998). The present study has been planned to evaluate the influence of pasteurization, sterilization and thermization on the sensory characteristics as well as shelf-life of treated skimmed milk.

MATERIALS AND METHODS

Milk sample

Buffalo milk obtained from Livestock Experiment Station, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam was used during the present investigation.

Equipments/utensils

Hot air oven

Hot air oven (Memmert 854, Schawabch W. Germany) was used for sterilization of equipments/ utensils during research work.

Analytical balance

Analytical balance (Adam, Model No. AAA 2502) was used to take weight of samples and chemicals during analysis.

Gerber centrifuge machine

Centrifuge machine (Funke Gerber, Model No. 12105 Germany) was used to centrifuge the samples during determination of fat con-tent of heat treated and untreated (control) skimmed milk samples.

Cream separator

Cream separator (Domo, Sweden) was used for skimming or separation of cream from whole buffalo milk.

Water bath

Water bath was used to process the skimmed milk samples for thermization.

Refrigerator

Refrigerator (Dawlance, 9188wbm, Pakistan) was used to store the milk samples during determination of shelf-life of the heat treated and untreated (control) skimmed milk samples.

Experimental procedure

The present study was conducted to observe the influence of various heat treatments on sensory quality and shelf-life of skimmed milk. The whole buffalo milk (3 L) collected from Livestock Experiment Station, Department of Livestock Management, was brought to the Dairy processing laboratory, Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. As soon as the milk was received, it was filtered through muslin cloth and volume was measured. Then, it was pre-heated to 40 C and transferred to the supply tank of cream separator for skimming. After skimming, the milk was measured into four equal parts and accredited with A, B, C and D codes. The samples of skimmed milk coded with B, C and D were heated at temperatures of 60 C for few s (Thermiza-tion), 65 C for 30 min (Pasteurization) and 110 C for 10 min (Sterili-zation), respectively while sample coded with A was kept as non-heated (Control) for comparison purpose. A total of six trials each in duplicate batches were conducted and analyzed for sensory cha-racteristics such as appearance/color, taste/flavor and body/texture scores and shelf-life at cold storage (6±2 C) and at room temperature.

Analysis of sensory characteristics

Sensory characteristics of thermizide, pasteurized, sterilized and un-treated (control) skimmed milk was analyzed according to the method as reported by Nelson and Trout (1981). A panel of five judges was selected from M.Phil. students of Department of Animal Products Technology. The judges were first familiarized with sensory profile of all the samples. Thereafter, the samples were offered for evaluation. The score was rated on hedonic scale of 10 for appearance/color, 45 for taste/flavor and 30 for body/texture.

Analysis of shelf-life

Shelf-life of each sample was obtained using clot on boiling (COB) test. 5 ml of each heat treated and untreated (control) skimmed milk samples were taken in screw capped test tubes and heated for 5 min. In case of any curd formation or precipitation noticed the sample was considered as expired.

Statistical analysis

The data was analyzed according to statistical procedure of ana-lysis of variance (ANOVA), and in case of significant differences, the mean were further computed using least significant difference (LSD) at 5% level of probability through computerized statistical package that is Student Edition of Statistix (SXW), version 8.1 (Copyright 2005, Analytical software, USA).

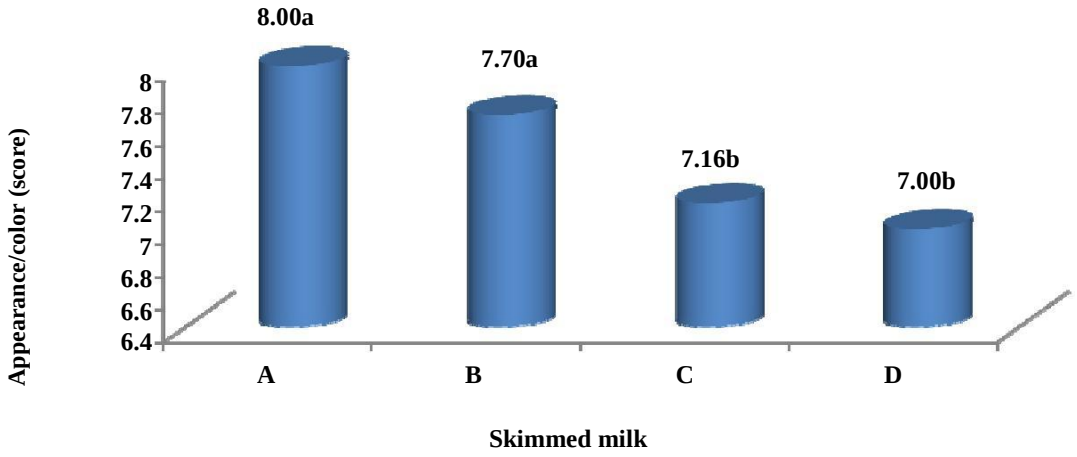

Figure 1. Appearance/color (score) of thermizide, pasteurized, sterilized and control skimmed milk. LSD (0.05) = 0.3477; SE± = 0.1667.

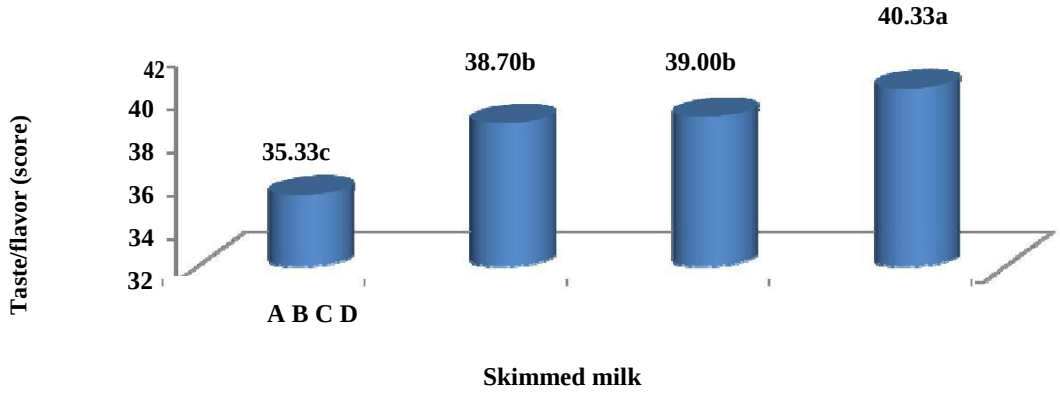

Figure 2. Taste/flavor (score) of thermizide, pasteurized, sterilized and control skimmed milk. LSD (0.05) = 1.3193; SE± = 0.6325.

RESULTS

Effect of heat treatments on sensory quality of skimmed milk

Appearance/color

The appearance/color score of heat treated and untreated (control) milk was evaluated by judges and score perceived is shown in Figure1. Results reveal that no remarkable (P>0.05) influence of thermization process was on appearance/color of skimmed milk. The score rated for thermizide skimmed milk (7.7) was not significantly different from that of control skimmed milk (8.00). More-over, pasteurization and sterilization processes revealed statistically comparable (P<0.05) results. Regardless, the score rated for pasteurized and sterilized skimmed milk was relatively similar (P>0.05), and the score rated for untreated (control) skimmed milk was comparatively (P<0.05) higher than that of pasteurized and sterilized skimmed milk.

Taste/flavor

The taste/flavor perception scores of various heat treated and untreated (control) milk was evaluated by judges and score perceived is presented in Figure 2. The taste/flavor score was improved in heat treated skimmed milk compared to un-treated (control) skimmed milk [35 to 36 to untreated (control) skimmed milk samples]. It was noticed that the heat treated (thermizide, pasteurized and sterilized) skimmed milk samples received better taste/flavor scores (38.70±0.54, 39.00±0.63 and 40.33±0.33, respectively) compared to that of un -treated skimmed milk (35.33±0.21). Moreover, LSD (0.05) comparison of means revealed that thermization and pasteurization processes has similar influence (P>0.05) on taste/flavor score of skimmed milk, while sterilization process perceived better score for taste/flavor among both these processes.

Body/texture

The body/texture scores of heat treated and un-treated

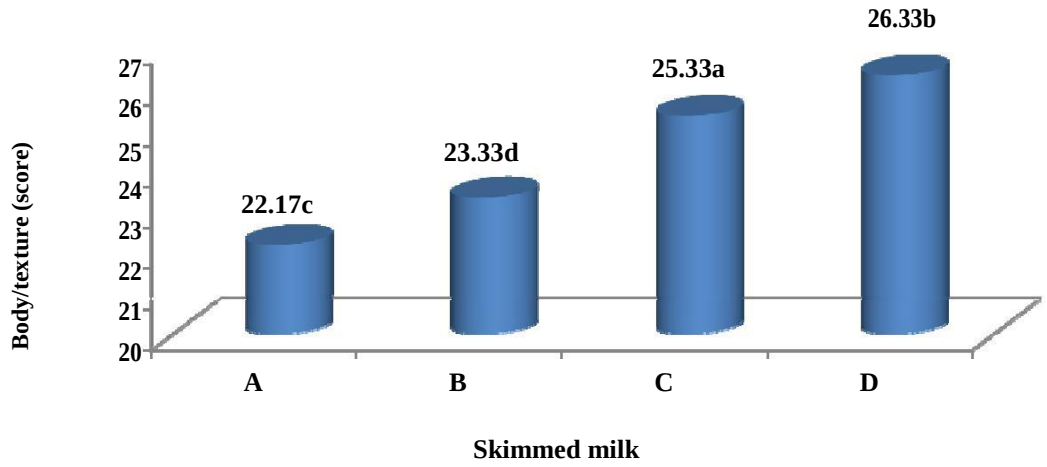

Figure 3. Body/texture (score) of thermizide, pasteurized, sterilized and control skimmed milk. LSD (0.05) = 0.8004; SE± = 0.3837.

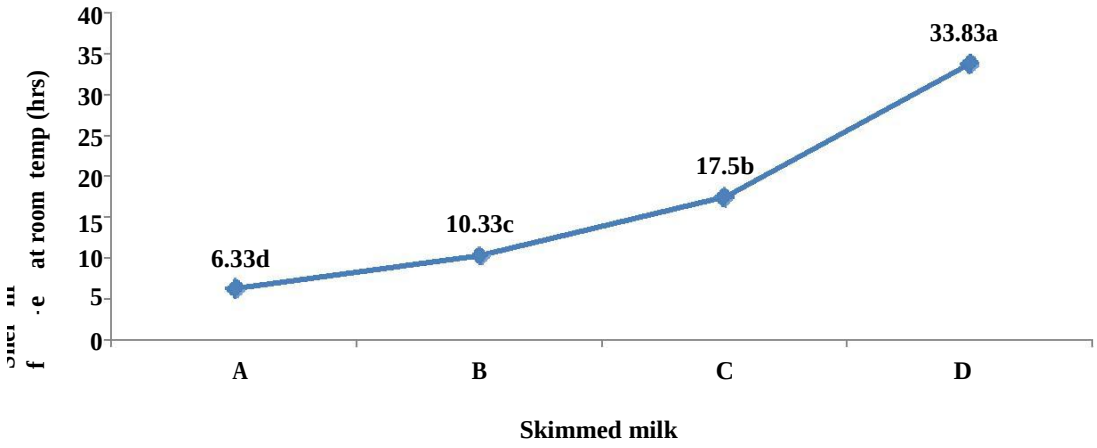

Figure 4. Shelf-life of thermizide, pasteurized, sterilized and control skimmed milk at 30 C. LSD (0.05) = 0.7125; SE±; = 0.3416.

(control) milk was evaluated by judges and the rated score is shown in Figure 3. The body/texture score was improved with thermization, pasteurization and sterilization processes. Control skimmed milk received an average score (22.17±0.17) from total of 30. The score was en-hanced to 23.33±0.33 in thermized skimmed milk, 25.33±0.21 in pasteurized and 26.33±0.33 in sterilized skimmed milk samples.

Shelf-life of treated and untreated skim milk at room temperature and 6±2 C

The shelf-life of thermizide, pasteurized, sterilized and un-treated (control) milk samples stored at room tempe-rature and cold storage (6±2 C) was evaluated through clot on boiling (COB) test, and the results are presented in Figure 4. It was found that un-treated (control) skim-med milk samples gave positive results on COB within 6 h of storage at room temperature and 1 day (24 h) at cold storage (6±2 C) temperature. Similarly, the average shelf-life was 11 h at room temperature and 3 days on cold storage (6±2 C) temperatures, for thermizide skimmed milk samples, 18 h at room temperature and 12 days at cold storage (6±2 C) temperatures, for pasteurized skimmed milk samples and 33 h at room temperature and 28 days at cold storage (6±2 C) temperatures, for sterilized skim-med milk samples.

DISCUSSION

The shelf-life of untreated (control), heat treated skimmed milk samples were evaluated through COB under room and cold storage (6±2 C) temperatures. It was concluded that shelf-life of skimmed milk was significantly less than that of whole milk treated at various pasteurization tem-peratures. The present results are in favor of the findings

by Janzen et al. (1982), who observed that skimmed milk has significantly less shelf-life than whole milk because of greater proteolysis in skimmed milk as compared to whole milk, thus resulted to increase in the production of protease enzyme which increases the susceptibility of protein to protease attack thus decreases the shelf-life of the treated skimmed milk samples.

The overall acceptability was increased with increase temperature in treated skimmed milk samples as compared to untreated samples in the present study. These findings are in contrast to the results of Hussain (2011), who reported that changes in temperature adversely affected the scores for taste, appearance and body of skimmed milk. He further reported that the changes in organoleptic properties of skimmed milk could occur due to proteolysis process, lactose degradation, millard reaction, etc. which is much faster in samples treated above 100 C and the results in changing the color and flavor of milk samples. Present results are also in cross with the findings by Petrus et al. (2011), who concluded that temperatures ranged from 72 to 94 C/ 15 s has no effects on sensory characteristics of milk.

In the present study, the skimmed milk was prepared from whole buffalo milk at the Department of Animal Pro-ducts Technology, Sindh Agriculture University Tandojam, during year 2012-2013, and processed for thermization (60 C for few s), pasteurization (65 C for 30 min) and sterilization (110 C for 10 min) processes. All the heat treated skimmed milk samples were examined against the control (un-treated) skimmed milk for physico-chemical (pH, titratable acidity, and specific gravity, moisture, fat, protein, lactose and ash contents), sensory attributes (appearance/color, taste/flavor and body/texture) and shelf-life.

Perception score rated for the appearance/color of the pasteurized and sterilized skimmed milk was relatively similar ($P>0.05$), but control skimmed milk was rated comparatively ($P<0.05$) higher score from that of all treated skimmed milk samples. The score rated for taste/ flavor was found to be higher in sterilized skimmed milk in comparison to all other samples whereas, thermization and pasteurization processes showed similar ($P>0.05$) influence on taste/flavor of skimmed milk. Body/texture of skimmed milk was improved as temperature was increased. The score rated for sterilized milk was significantly ($P<0.05$) higher, followed by pasteurized, thermizide and control skimmed milk samples. The shelf-life of sterilized skimmed milk under room temperature and cold storage (6±2 C) was significantly ($P<0.05$) higher followed by pasteurized, thermizide and control skimmed milk.

Conclusion

The taste/flavor and shelf-life of skimmed milk were remarkably improved with the use of sterilization process.

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