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Storage Impacts on Organoleptic Characteristics of UHT Treated and Whole Milk Powder

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Abstract: UHT treated and whole milk powder undergo organoleptic changes like colour, flavour, taste and overall acceptability during storage at room temperature. These changes were more visible in UHT treated milk as compared to whole milk powder during storage period of 90 days. The mean values for colour, flavour, taste and overall acceptability score were similar to one another during the entire storage period of 90 days when analyzed after a period of 30 days in case of UHT treated milk. The mean values for score of these organoleptic characteristics at 60 and 90 days storage were significantly lower than the mean values at 0 and 30 days storage in case of UHT treated milk. Changes in colour of whole milk powder appeared at 90 days storage as the mean values for colour score at 90 days storage were significantly lower than the mean values at 0, 30 and 60 days in case of whole milk powder. The mean values for flavour score at 60 and 90 days storage were significantly lower than the values at 0 and 30 days storage. No change in taste and overall acceptability was observed during the entire storage period of 90 days in whole milk powder as the mean values for these characteristics remained non-significant during the entire storage period.

Key words: UHT treated milk, whole milk powder, storage, organoleptic changes, quality deterioration

Introduction

Milk constitutes an integral part of the human diet from infancy to age and is considered practically a complete food and is consequently rather complex in nature. Milk is legally defined as "the lacteal secretion , practically free of colostrum, obtained by the complete milking of one or more healthy cows. Milk that is in final form for beverage use shall have been pasteurized or ultra pasteurized and shall not contain less than 8.5% of milk-solid-not-fat and not less than 3.25% milk fat (FDA,1988). Buffalo's milk contains 6.86 % ± 0.04 fat, 4.77% ± 0.31 protein, 5.23 % ± 0.06 lactose, 0.70 % ± 0.009 ash, 8.75% ± 0.19 SNF, 84.55 % ± moisture with 1.0288 specific gravity (Jabbar, 1983) Ultra high temperature (UHT) treated milk and whole milk powder both packed aseptically, undergo various organoleptic changes like colour, flavour, taste and overall acceptability during heat treatment and subsequent storage at ambient temperature. Dried milk stored under different conditions (at 5,15,25,30, and 35°C) under low or high humidity, wet or dry N_2 atm in paper or plastic containers indicated that temperature, humidity, packaging materials and duration of storage all had an effect on stability of milk protein. Storage at 15°C in airtight plastic bags with saturated humidity enabled dried milk to be kept for 8 weeks without deterioration (Kang *et al.,* 1983). Quality of UHT milk is influenced by the action of lipases on damaged fat globules in raw milk resulting in rancid flavour in the finished product. Fat globules may be damaged during pumping and agitation. Maintaining the temperature of raw milk below 4 °C will minimize the lipolytic activity (Macrae *et al.,* 1993). Samples of commercially processed UHT milk (indirect heating at 140°C/3 s) packed in polylaminated paper cartons were stored at 22 and 37°C. During storage at 22 and 37°C resp., log psychrotrophic spore count increased from 0.77 initially to 2.61 and 2.46 on day 22, total spore count increased from 1.0 initially to 2.39 and 2.63 on day 32. Titratable acidity increased gradually from 0.135 to 0.177 and 0.192 after 33 days and a pronounced rancid flavour was noted after 25-26 days and 21-22 days (Adhikari and Singhal, 1992). Present research project was under taken to assess and evaluate organoleptic changes resulting in quality deterioration in UHT treated milk and spray dried whole milk powder stored at ambient temperature for a period of 90 days. Consumption of UHT treated milk in particular and whole milk powder in general is going to be increasingly popular in our country. It is imperative to determine the organoleptic changes and to find out the reasons of quality deterioration during storage of UHT treated milk and whole milk powder.

Materials and Methods

The experiment was conducted in the laboratory of Milk Pak Limited Lahore(Nestle) where the raw milk was received form the collection centers. The initial tests of the raw milk were performed in the milk reception laboratory of the same plant to accept it for processing. Milk was then deareted, measured, chilled to 4 °C, standardized to 3.5% fat and 8.9 % solid not fat, pasteurized, treated at ultra high temperature i.e 140-145 °C for 3 seconds in the main processing plant and was packed aseptically on fully automatic machines. Whole milk powder was produced by spray drying with hot air at temperature 325 °F and milk pressure 1500-4000 lbs., after separation of cream, pasteurization, evaporation and homogenization and was packed in Al foils as well as tins. Freshly packed samples of both types of milk were brought to the main experimental laboratory of the same plant and organoleptic tests for colour, flavour, taste and overall acceptability were done with fresh samples by scoring method as described by Larmond (1977) by presenting the samples along with score sheet with quality description scale from 0 to 9 to a panel of judges comprising dairy experts. Rest of the samples were stored at room temperature for subsequent organoleptic analysis at 30 , 60 , 90 days storage in the manner stated above. The experiment was conducted in a completely randomized design and data were analyzed by using analysis of variance and mean separation was done by using LSD.

Results and Discussion

Colour changes were not observed from 0 to 30 days storage interval but the colour score decreased at 60 and 90 days storage in case of UHT treated milk where as whole milk powder showed no change in colour till 60 days storage and the only change in colour of whole milk powder appeared at 90 days storage. The mean values for colour at 60 and 90 days storage were significantly lower than at 0 and 30 days storage in UHT treated

milk Table 1. The mean values for colour score in case of whole milk powder were significantly different and were lower at 0,30 and 60 days than at 90 days storage Table 2. Brown

Table1: Organoleptic changes and quality deterioration in UHT treated milk stored at room temperature

Storage period days	Colour	Flavour	Taste	Overall Acceptability
0	7.000 a	7.667 a	7.000 a	7.000 a
30	6.667 a	6.667 a	6.667 a	6.667 a
60	5.667 b	6.333 b	5.667 b	5.667 b
90	4.667 c	4.667 c	4.333 c	4.333 c

Mean in columns followed by the same letters are non-significantly different (LSD: 0.05)

Table 2: Organopleptic changes and quality deterioration in whole milk powder stored at room temperature

Storage period days	Colour	Flavour	Taste	Overall Acceptability
0	6.667 a	7.667 a	7.000 a	7.000 a
30	7.000 a	7.667 a	7.000 a	7.000 a
60	6.667 a	7.333 b	6.667 a	6.667 a
90	6.333 b	6.667 b	6.667 a	6.667 a

Mean in columns followed by the same letter are non significantly different (LSD:0.05)

discoloration of UHT treated and whole milk powder is due excessive heating i.e. 145 ℃ for 3 seconds as a result of Maillard reaction in which hydroxymethylfurfural (HMF) is produced which possess brown colour and appears in the early stages of Maillard reaction. 31 samples of UHT treated milk with abnormal characteristics were reported and samples with brown discoloration appeared to have undergone Maillard browning reaction due to excessive heating (Centrich Sureda and Suarez Garcia, 1988) Appearance of brown colour at 60 and 90 days intervals might be due to the storage temperature as the effect of storage temperature can not be ignored in the development of discoloration both in UHT treated and whole milk powder. Effects of two heat treatments on shelf life of milks after storage at 2 and 10 °C were compared. Results showed that there was no significant difference between the two treatments in shelf life of milk stored at 2 °C . In milk stored at 10 °C samples which had been heat treated at 72 °C deteriorated markedly after 15 days with total aerobic mesophylic count rising from 2.54 -2.92 cfu/ml on day 1 to 5.95-7.00 cfu/ml on day 15. In samples treated at 115 °C however total aerobic count decreased from 2.11-2.74 to 1.00-2.70 cfu/ml during the same period and the milk had satisfactory quality after 22 days (Borde Lekona *et al.*, 1995). Kieseker and Clark (1984) studied the storage of milk powders and reported that milk powders deteriorate during storage ,the rate of change depends on a number of factors including powder characteristics and storage temperature. Studies were conducted to investigate the quality changes of aseptically filled and unsterilized filled UHT milk during storage. The results can be summarized as follow; hydroxymethylfurfural content of aseptically filled UHT milk was higher than that of unsterilized filled UHT milk, whereas it decreased during the storage period. Flavour changes could be observed during storage(Yoon *et al.*, 1991).The mean values for flavour score in case of UHT treated milk manifested almost the similar trend of decreasing from 30 to 90 days with no change from 0 to 30 days storage period as it happened in case of colour score Table 1. Values for flavour in case of whole milk powder showed non significant difference from 0 to 30 days storage and the values for flavour score were significantly lower at 60 and 90 days storage Table 2. So the change in flavour appeared at 60 and 90 days storage. UHT buffalo milk containing (i) 5% and (ii) 6% fat was subjected to sensory evaluation at 4 days intervals throughout storage for 6 weeks at 30°C. Mean flavour scores of (i) and (ii) resp. were 49.8 and 51.3 initially and after increasing slightly during the first week of storage decreased steadily to 36.2 and 32.0 on day 41 Scores for colour reached max. of (i) 9.5 on day 17 and (ii) 8.8 on day 13 and was significantly correlated with HMF conc in (ii) Overall sensory scores of (i) and (ii) resp declined from 88.3 and 89.2 initially to 86.3 and 87.8 on day 17 and to 69.6 and 62.0 on day 41 (Singh and Patil, 1989). Flavour and taste are much related characteristics and any change in one influences the other. The mean values for taste score were exactly similar to those of flavour in case of UHT treated milk viz. no significant difference in values at 0 to 30 days storage and significant decrease in score at 60 and 90 days storage was observed Table 1. No change in taste during the entire storage period of 90 days was observed as the values remained non significantly different at each interval of 30 days in case of whole milk powder Table 2. Values for overall acceptability remained non significantly different and no change in the score was observed in case of whole milk powder Table 2. Dried milk has a longer shelf life as compared to UHT treated milk and the organoleptic value of the product does not normally change within a storage period of 90 days as reported by Ipsen and Hansen (1988) that the correlation between milk quality before drying and after dried milk flavour could be established only after storage for ≥ 5 weeks; flavour deteriorated on storage irrespective of its initial quality. Nevertheless there are numerous factors which may influence the flavour and taste of the dried milk even during a 90 days storage like packaging material, drying conditions, moisture contents, particle size distribution and mineral contents. The present samples of spray dried milk powder were having 2% moisture contents and an increase in moisture contents may have an influence on the structural as well as organoleptic value of the product. Both proteases and lipases can appear in milk as a result of bacterial growth. Some of these enzymes are extremely heat resistant and they are able to survive UHT treatment, which lead to off flavour, change in taste and overall acceptability. Changes in UHT sterilized milk during storage, particularly at higher than ambient temp., involve destabilization of the colloidal state of micellar casein, leading to defects such as sedimentation and gelation or development of off-flavour such as stale, oxidized rancid, bitter and astringent resulting from proteolysis breakdown products (Harwalker, 1991). Reconstituted UHT milk was produced from dried whole milks that were manufactured in Australia from fresh (control) or stored (4 ± 1 °C for 48 ± 2 h raw milk and stored up to 8 months at 25 ± 1 °C. Lipolytic and proteolytic activities, physico chemical and flavour changes and gelation in UHT milk during storage at 3 ± 1 or 25 ± 1 °C for up to 6 months were investigated in relation to the bio chemical status of the raw milk and the dried whole milk. The green red and blue yellow contents of colour of UHT milk increased while pH and colour lightness decreased with storage. The rate of change was greater at the higher storage temperature. Lipases and proteinases were reactivated during storage and their activity was greater in UHT milk processed from dried milk manufactured from stored raw milk. The taste of reconstituted UHT milk was affected more by lipolysis than by proteolysis (Celestino *et al.*,1997). Organoleptic characteristics are greatly affected on account of oxidation reaction in UHT treated milk as reported byAdhikari and Singhal 1990 that UHT milk (4.5% fat, 8.9%

SNF) processed by indirect heating and packed in 0.5 litre tetrapaks were stored at 22 and 37°C. Dissolved O_2 decreased from 8.4 ppm initially to 3.4 and 4.00 ppm at 22 and 37 C resp. after 34 days. The decrease was rapid for the first 14 days resulting in a sharp decrease in free S-H compounds and in cooked flavour. Ascorbic acid decreased from 2.2mg/100ml to almost 0 after 30 days with gradual increase in oxidized flavour after 14 days. Flavour score was maximum after 13-14 days at both temperatures.

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