Development of Calcium Fortified Flavoured Pasteurized Milk for Pregnant and Breast Feeding Women

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Introduction

Calcium is the most abundant mineral in the body which is essentially required for building and maintaining strong skeletal system and to maintain metabolic processes. Body calcium requirement increase dramatically with age and specially during the pregnancy and lactation. The clinical implications of calcium deficiency include rickets, poor bone mass accrual, abnormal foetal programming during pregnancy, postmenopausal osteoporosis and osteoporosis in elderly. Women are more susceptible to calcium deficiency than male as the body calcium deposits readily deplete during pregnancy and lactating period. Most of the governments and health organizations in the world initiate different approaches to increase the calcium intake during pregnancy and lactation. In Sri Lanka, government provides calcium supplements to pregnant women in the form of drug for daily administration. Though the supplements are provided continuously, the problem is still remaining. Recent medical researches indicate that more than 35% Sri Lankan people are suffering from osteoporosis. This is mainly due to poor dietary intake and low bioavailability of supplemented calcium than the natural sources of calcium. Milk is an excellent source of vitamins, minerals and particularly calcium. It has long been recognized for its important role in the bone health. Milk contains about 117 mg of calcium in 100 g of milk (Walstra *et al.*, 2006).Calcium in milk is more easily absorbed by the intestine than the calcium from the vegetables and cereals, thus dairy products are considered as excellence sources of dietary calcium which can be further fortified with calcium source to achieve higher calcium intake per saving (Singh *et al*, 2006). Though the fortification is possible, development of calcium fortified products with good sensory and appealing properties is one of the challenges faced by the dairy industry. Hence, this research was conducted to select the best source of calcium for fortification of milk with higher sensory attributes, good solubility and low cost of production.

Methodology

Sensory properties of calcium fortified milk were developed through a series of preliminary trials. Initially, the best source for the fortification was selected from three different sources of calcium; Calcium Chloride ($CaCl_2$), Calcium Carbonate ($CaCO_3$) and Tri Calcium Phosphate ($Ca_3(PO_4)_2$). They were fortified in to milk as 6.53 g, 5.89 g and 6.08g respectively. Best source was selected by sensory evaluation using 15 trained panelists.

Then, the best flavour profile for fortified milk was selected using three types of flavours as chocolate, vanilla and strawberry. The best flavour profile that masks the chalky mouth feel of selected calcium source was decided trough sensory evaluation. Then, the best stabilizer percentage was selected by preparing fortified milk with different carrageenan levels as 0.02%, 0.04%, 0.08%, and 0.1%. The best stabilizer percentage was selected by means of

sensory evaluation for its taste, texture, mouth feel and overall acceptability. The sugar content of fortified milk was reduced up to a level which could not disturb the sensory characteristics of the fortified milk as the health implications recommended to lower the sugar intake during pregnancy. Four different treatments were carried out with changing sugar content slightly. The lowest sugar percentage that provides better sensory properties was selected. Similarly, best percentage of vanilla flavour which provides maximum sensory properties under selected sugar level was determined. All the sensory evaluations were conducted with 15 trained panelists and five point hedonic scales were used. Sensory data was analysed using Friedman non- parametric test.

Three different pasteurization methods; 90 °C for 5 minutes (T_1), 80 °C for 10 minutes (T_2) and 70 °C for 15minutes (T_3) were applied to determine time-temperature combination for the pasteurization of calcium fortified flavoured milk.. Then, the soluble calcium content was analysed using Atomic Absorption Spectroscopy (AA-240, Australia). The data obtained from the spectroscopic method was analysed by basic descriptive statistics in Minitab 14 software. Shelf life of the final product was determined through microbiological evaluation, pH and titrable acidity (TA) over seven days of period at 4 °C.

Results and Discussion

$CaCO_3$ was selected as the best source of calcium for fortification in terms of taste, colour, odour, mouth feel and overall acceptability ($p<0.05$). Use of $CaCl_2$ resulted bitter and salty taste in fortified milk and agrees with the findings of Singh *et al.* (2006). The use of $CaCO_3$ however, reduces the flavour properties of milk due to its chalky taste and gritty mouth feel but the use of vanilla flavour to mask the chalky flavour of $CaCO_3$ was highly effective ($p<0.05$). The selected level of carrageenan was 0.04% and use of carrageenan in higher levels resulted slimy texture and gel formation upon cooling. Carrageenan in 0.04% was effective in masking the gritty mouth feel of the $CaCO_3$ in fortified milk. Gerhard (2004).has also reported that the use of carrageenan in relevant concentrations can improve the mouth feel of $CaCO_3$ fortified dairy and soy drinks. The Figure 1 indicates the spectroscopic analysis of milk samples under different pasteurization methods and records the highest mean and median value for treatment 3 indicating that heating fortified milk for long time can increase the solubility of $CaCO_3$. Gerhard (2004) also has stated that heating of fortified milk for long time with vigorous stirring can improve the solubility of $CaCO_3$.

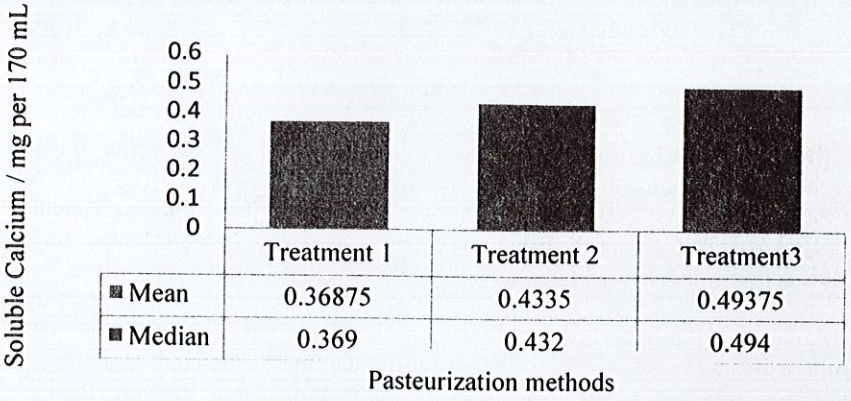

Figure 1: Soluble calcium content of fortified milk under different pasteurization methods

Titratable acidity of final product increased with the storage time (Figure 2). Acidity of selected milk was 0.02% at day 1. This low acidity is due to the addition of $CaCO_3$to milk. However, with the storage the acidity increased due to formation of lactic acid by lactic acid bacteria present in milk.

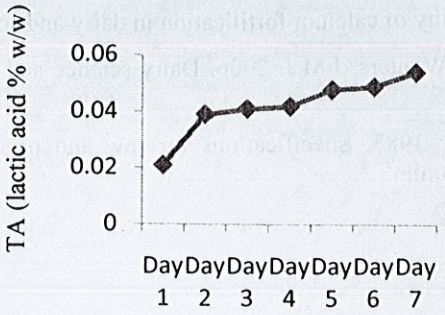

Figure 2: TA during storage period

Total plate count (TPC) has gradually increased during the storage period (Figure 3). After six days, TPC exceeded the acceptable range (10,000 cfu/mL). According to Sri Lanka Standards for raw and processed milk (1983), coliform count should remain negative during the shelf life. Thus, the product has a five days shelf life.

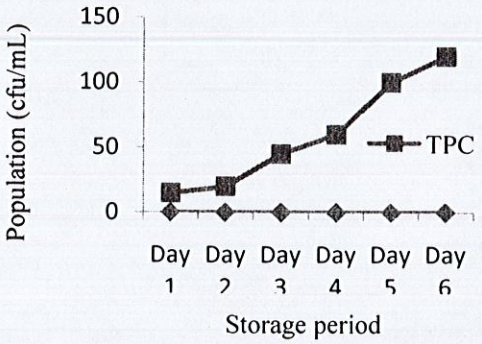

Figure 3: Coliform count during storage period

Conclusion

$CaCO_3$ is the best source of calcium for fortification of milk. Adding vanilla flavour to the fortified milk increases the consumer acceptance by masking the undesirable taste of $CaCO_3$. Addition of carrageenan as a stabilizer improves the sensory properties of fortified milk by reducing gritty mouth feel associated with $CaCO_3$. Solubility of calcium carbonate is higher when the pasteurization time period is longer.

References

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