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Research Article

PROCESS OPTIMIZATION AND SHELF LIFE STUDY OF RETORT PROCESSED ROSE FLAVOURED MILK

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ABSTRACT
Flavoured milks in a ready –to-drink form are in a great demand in the domestic and international market and it was thermally processed in retort pouches having three layer configurations. The present study was undertaken to optimize and standardize shelf stable ready-to- drink rose flavoured milk packed in non-transparent and transparent retort pouches and were subjected to thermal processing to a lethality values of f_o 3.95 and 3.8 respectively. Shelf life study revealed that the ph values decreased from (6.66 to 6.44 and 6.66 to 6.42), the acidity (0.14–0.18) increases. The specific gravity of the rose flavoured milk (1.035-1.037) showed a slight tendency to increase with increase of viscosity (1.479-1.507 and 1.480-1.507).retort processed rose flavoured milk had significantly lower l*, a*, b* and chroma values. Product was superior in all sensory attributes which is a normal physico-chemical change but all the flavoured milks were microbiologically safe.

Keywords: *Rose Flavoured Milk, Transparent, Non-Transparent, Milk Beverages*

INTRODUCTION
Milk with more than 200 ingredients of functional and nutritional properties, is an essential part of human diet. Milk production in India involves millions of small producers with little or no land, each of them raising one or two low yielding, non-descript cows or buffaloes. Presently, more than 77000 village dairy co-operatives societies have been opened up in India, where more than 10.4 million farmers are members. From the point of milking to the dairy, there are milk losses during milking, handling, transportation, processing etc. Farmers are getting less value for money due to losses in handling and processing of milk and indulge into adulteration of milk. Hence, there is a need to develop processing methods to add value, increase shelf life and increase farmer’s income. For this purpose, small scale processing and packaging machines, relevant in rural areas, will have to be developed (Chatterjee *et al*., 1992). Thermal sterilization of milk is a low cost alternative and is one of the most effective means of producing room temperature stable milk without the addition of any preservatives (Karel *et al*., 1975). Thermal processed foods not only eliminate the need for refrigeration but also have long shelf life compare to any other food processing technique. Though cans made of different metals could be used for thermal processing, use of flexible laminated retortable pouch, which can withstand thermal processing has the advantages of faster heat penetration, lower processing cost, easy transport and better consumer appeal (Gopakumar and Gopal, 1987). The development of retort pouch dates back to as early as 1940 in United State of America (Gould *et al.,* 1962). The concept of retort pouch was originally implemented at the University of Illinois in the United States (Hu *et al.,* 1955). Currently, such pouches, in general consist of three layers namely polyester/aluminium foil/cast polypropylene (Griffin, 1987). The polyester film on the outer layer gives the pouch the strength as well as printability. The core of aluminium foil is used to give the laminate the necessary water, gas, odour and other barrier properties. The primary function of polypropylene inner ply is to give good heat seals and product resistance. The polypropylene ply on the inside also protects the aluminium foil and contributes to the overall strength. Some manufacturer supply 3-ply laminated non transparent retort pouches composed of PET, Nylon and polypropylene whereas the transparent pouches with ALO_xPET, biaxially oriented nylon and polypropylene. Incorporation of nylon film reduces the gas transmission rate and contributes to the strength of packaging materials (Gopal *et al*., 2001). ALO_xPET is having the high tensile strength, gas and moisture barrier. Standardization of different types of retort

processed milk products were reported. The products are dairy dessert dali (Jha *et al*., 2012), dairy dessert kheer (Jha *et al*., 2011) and retort sterilized dairy beverages. The flavoured milk is prepared by addition of different flavours e.g. Vanilla, chocolate, cardamom, coffee, rose or any other edible flavor, edible food colours and sugar to the milk. Flavoured milk industry is having huge market potential as it is a regular drink for refreshment in India and also offers the farmers the option of increasing their income. Flavoured milk should be pasteurized, sterilized or boiled (Srivastava, 2010). Due to the higher market potential of retort processed milk beverages with longer shelf life, the present work was undertaken with the following objectives: to develop a commercial process for manufacture of retort processed rose milk drink compared to conventional in bottle sterilized product with poor consumer appeal, to find out the changes in physical, chemical, microbiological and nutrient quality of retort processed rose milk beverages and study the storage life of retort processed milk beverages.

MATERIALS AND METHODS

Physico-Chemical Properties of Non-Transparent and Transparent Retort Pouch

The 3-ply laminated non transparent retort pouches used in study had a total thickness of 97μ composed of 12μ PET, 15μw Nylon and 70 μ poly prophylene where as the transparent pouches of total thickness was 97μ composed of 12μ ALOxPET, 15μ Biaxially oriented nylon and 70μ cast poly prophylene. Both pouches showed resistance to product and process at 121.1^0 C and 15 psi. The laminates showed good tensile strength in both machine direction and cross direction with 20% of elongation at break. The heat seal strength was comparable for both pouches and durability to withstand high pressure and temperature. The water vapour transmission rate and oxygen permeability of the pouch were within the recommended levels and was slightly better for non-transparent pouches. The global migration rate of the transparent and non-transparent pouches were studied using the solvents , n-heptane was higher than those into water and 3% acetic acid. However all the values were well below the prescribed limit of 10 mg/dm^2.

Standardization of Rose Flavored Milk for Retort Processing

Double toned milk was processed at three different Fo value using over pressure retort and the best adjudged process parameter was used for subsequent trails. Then the level of incorporation of Rose flavour (0.05%, 0.1% and 0.2%) was optimized. The product which commanded highest sensory acceptance was further subo storage study for a period of three months.

Storage Study

Thermal Processing of Rose Flavored Milk

The standardized rose flavored milk with highest sensory acceptance from these trails was processed in both transparent and non-transparent pouches and was studied for heat penetration characteristics. The rose flavored milk was prepared packed in transparent and non-transparent retort pouches were processed in an over pressure autoclave at 121°C to a Fo value of 3.95 and 3.8 (Figure 1 & 2).

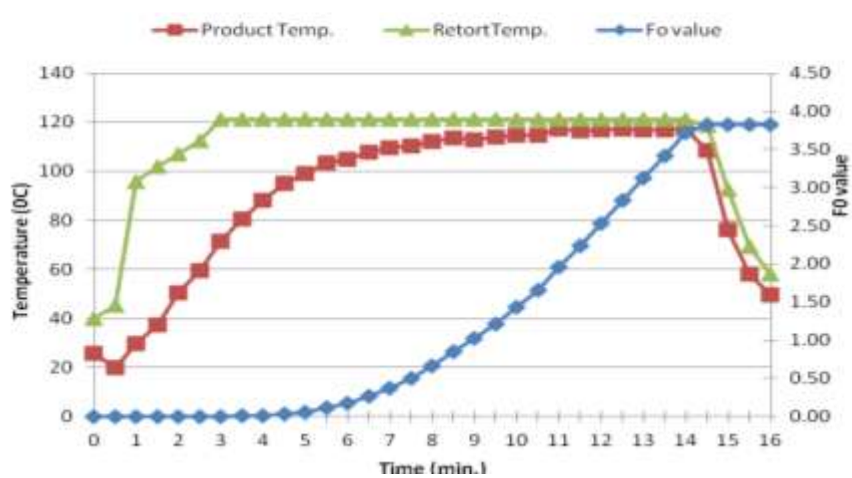

Figure1: Heat penetration curves of rose flavored milk packed in non-transparent retort pouch

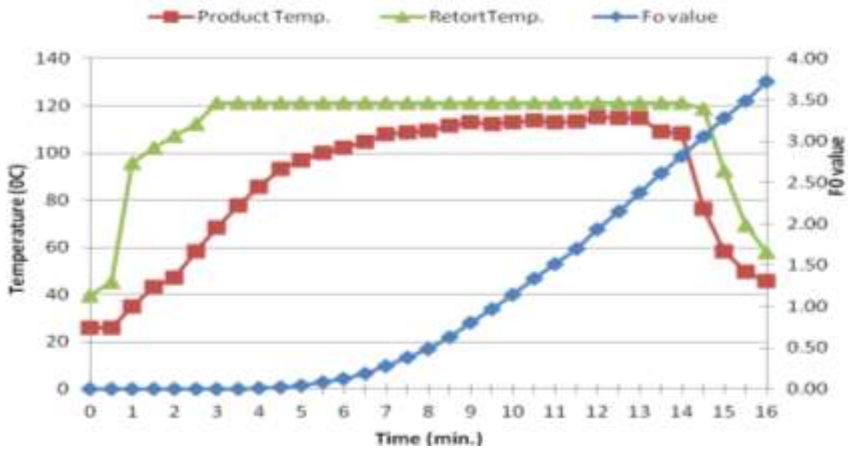

Figure 2: Heat penetration curves of rose flavoured milk packed in transparent retort pouch

Heat penetration data were obtained by using thermocouple glands through which thermocouple was inserted. The tip of the thermocouple was inserted into the rose flavored milk for recording the core temperature during heat processing in a still over pressure retort (M/s Lakshmi Engineering Pvt. Ltd., Chennai, India). The thermocouple outputs during heat processing were collected using an Eval (Ellab A/S, Roedovre, Denmark). Data recorder cum Fo and heat penetration characteristics were determined. After heat processing to require Fo value of 3.95 and 3.8, the retort pouches were rapidly cooled by pumping water into the retort. The lag factor for heating (J_h), slope of the heating curve (f_h), time in minutes for sterilization (U) and lag factor for cooling (J_c) were calculated by plotting temperature deficit (RT-Tc) against time on semi log paper. The process time (B) was calculated by mathematical method (Stumbo, 1973). The total process time was calculated by adding 42% of the come up time to (CUT) to B. The processed trays were tested for sterility by using thioglycolate broth medium as per the method described in IS: 2168 (1971).

Physico Chemical and Sensory Evaluation

pH, Acidity, Specific gravity and viscosity of the processed samples were analyzed by the method of AOAC (2005) . Colour of the sample was tested using Hunter lab Mini scan XE plus Spectrocalorimeter (Model No. *45/0-L,* Reston Virginia, USA) with geometry of diffuse /80 (sphere - 8mm view) and an illuminant of D-6511 (Bindu *et al*., 2007). Sensory analysis of rose flavored milk was done by 12- non trained panelists using 9-point hedonic scales. The panelists were asked to score for colour, flavor and overall acceptability for the samples.

Microbial Quality Analysis

The samples were tested for commercial sterility. They were evaluated for Total viable count, Anaerobic, Coliform, Yeast and mould counts by the method described by American Public Health Association (APHA), 1984. The medias used were from Hi-Media, Mumbai.

Statistical analysis

The data obtained were analyzed statistically in SPSS software (Version 20.0) as per the standard procedure of Snedecor and Cochran. Results were expressed as mean or mean log ± standard deviation.

RESULT AND DISCUSSION

Physical Properties of the Non-Transparent and Transparent Retort Pouches

The physical properties of the pouch were studied and the results are given in Table 1. The three-layer configured retort pouches were found suitable for food contact application. The suitability of retort pouches for thermal processing was studied by various physico-chemical tests (Table 1). The non-transparent and transparent retort pouches used in the study were of size Pouch size 140 mm x 185 mm x 40 mm and 140 mm x185 mm x40 mm with total thickness of 110 µ. The thickness of outer poly ethylene terphthalate (PET) or ALOXPET was around 12 µ, middle biaxially oriented Nylon or Nylon layer was around 15 µ and inner cast polypropylene layer was around 70 µ. Both the pouches are microwavable. The tensile strength of the material, which determines the resistance to rupture and breakage when subjected to tensile forces, was higher in machine direction than in cross direction. The pouches had high tensile strength in both the machine and the cross direction, which is satisfactory for withstanding the rigors of heat processing in an over pressure autoclave. The heat seal strength, an important property for packaging integrity and to provide good shelf-life, was high in machine direction than in cross direction. These results are in agreement with the earlier reports by (Ravishankar, 2002; Vijayalakshmi *et al*., 2003; Manju *et al*., 2004). The minimum requirement of bursting strength is 20-30 psig (Lampi, 1980). Lower levels of bursting strength will lead to easy delamination of the layers during thermal processing which results in physical destruction of the pouch and reduction in barrier properties (Vijayalakshmi *et al*., 2003). The bursting strength of both transparent and non-transparent was 30 psig and is within the acceptable range. The migration of additives from pouch into food is inevitable, hence the migration test was conducted using food stimulants like distilled water, 3% acetic acid and n-heptane. The migration into n-heptane was higher than those in water and acetic acid, which is in agreement with the results reported by (Vijayalakshmi *et al*., 2003). This could be due to the structural similarity of n-heptane with the contact layer of cast polypropylene (Vijayalakshmi *et al*., 1992) .The migration residues were well below the limits described for a food contact material (FDA 1983). The water vapour transmission rate and Oxygen transmission rate for transparent and non-transparent retort pouches showed relatively lower value of 0.22 g m^{-2} for 24 h at 92% relative humidity and 37°C and 10.15 ±0.013 mL m^{-2} for 24 h at one atmospheric pressure respectively. Lower water vapour transmission observed indicates the suitability these pouches for thermal processing and the findings are in accordance with results described by (Mohan *et al*., 2008). The above results suggest that the retort pouches used in the study were most suited for thermal processing.

Table 1: Physico-chemical properties of non-transparent and transparent retort pouch

Parameters	Non Transparent	Transparent
Total thickness (µ)	97 ± 0.011	97 ± 0.008
Thickness of Poly Ethylene Terrephthalate (µ) /ALO x PET	12 ± 0.004	12 ± 0.007
Thickness of Biaxially Oriented Nylon /Nylon layer (µ)	15 ± 0.007	15 ± 0.005
Thickness of Cast Poly Prophylene layer (µ)	70 ± 0.001	70 ± 0.003
Tensile strength (kg/cm^2)		
(Machine direction)	421.61 ± 0.01	419.16 ± 0.02
(Cross direction)	403.43 ± 1.62	402.31 ± 0.62
Elongation at break		
(Machine direction)	20 %	20 %
(Cross direction)	20 %	20 %
Heat seal strength (kg/cm^2)		
(Machine direction)	374.75 ± 0.005	374.62 ± 0.006
(Cross direction)	362.60 ± 0.42	361.04 ± 0.25
Bond strength (g/25mm width) (Inner ply)	109.52	109.20
(Outer ply)	179.32	178.12
Bursting strength (psig)	30 ±0	30 ±0
Gas transmission rate (cc/m^2/24 hr at 1 atm. Pressure)	10.15±0.02	11.15±0.05
Water vapour transmission rate (g/m^2/24 hr at 37^0 C and 92% RH)	0.22±0.013	0.23±0.009
Global Migration (mg/dm^2)		
Distilled water (121^0 C / 2 hr)	0.6	0.6
3% acetic acid (121^0 C / 2 hr)	0.8	0.9
n-heptane (66^0 C / 2 hr)	3.74 ± 0.02	3.54 ± 0.02

Preliminary Trails for Standardization of Rose Milk Drink for Retort Processing

The preliminary study was carried out by processing the double toned milk in non-transparent pouch at different Fo values (3, 4, 5, 6 respectively). The results of sensory analysis shown that the range of acceptability was found to be good for the milk processed at the Fo value of 4. Milk processed at Fo value of 6 gave rise to uncharacteristic burnt flavour and was rejected by panellist. Subsequently, the standardisation with different concentration of rose flavour was carried out. The sensory study shown that the retort processed rose flavoured milk with 0.1% rose flavour had better sensory acceptability.

Storage Study

Thermal Processing

Rose flavoured milk with 0.1 % rose flavour was processed in both transparent and non-transparent pouches and was studied for heat penetration characteristics. The process parameters obtained for non-transparent and transparent retort pouches are presented in Table 2.

Table 2: Heat penetration characteristics of rose flavoured milk packed in transparent and non-transparent retort pouch

Sl. No.	Parameters	Non Transparent ret ort pouch	Transparent ret ort pouch
1	F_o	3.95	3.8
2	J_h	0.31	0.28
3	J_c	1.00	1.01
4	f_h	6.70	6.66
5	U	3.95	3.81
6	f_h/U	1.69	1.73
7	G	0.73	0.74
8	B	10.52	10.41
9	CUT	6.00	6.00
10	Total process time (min.)	14.60	13.97

In the retort processing, the time taken for a heat penetration curve to traverse one log cycle is called the heating rate index f_h value. Heating rate index (f_h) for convective heating of rose flavoured milk has been reported to be dependent upon temperature of heating medium and condensing surface, steam–air flow rate and direction, surface size and orientation, viscosity, film thickness and stagnant air layer thickness. Heating rate index (f_h) of non-transparent and transparent pouches were 6.70 and 6.66. These values are in the range of values reported for convection heating products, in contrast to conduction-heating products whose f_h values are reported to 5 or more times viz., 30-40 minutes (Horner, 1992). In a study involved with different levels of solid content in the Dairy dessert kheer, the f_h values increased from 2.82 to 8.70 minutes as the solid content decreased (Jha *et al.,* 2011). This may be due to the fact that compared to conduction-heating products, convection heating products have a large heat capacity and thermal diffusivity and reach retort temperature very quickly after which they remain essentially inert with respect to heat transfer (Weintraub *et al.,* 1989). Heating lag factor (J_h) of both pouches were 0.31 and 0.28. For purely convective packs, there is little or no lag period (i.e. the come-up time is very short); hence, PID and ID coincide, so that J_h is equal to 1.0 (Jones, 1968). However, in actual practice, there is always some gap in time period before a product could reach the retort temperature, leading to differences in come-up time depending on the composition, size etc. and hence to variations in J_h value. The reported J_h value for Dairy dessert kheer of different composition ranged from 0.44 to 1.17. The values observed in this study were lower than this as the rose flavoured milk is comparatively less viscous with no solids in it. Higher values of J_h was observed retort processed prawn kruma which has high solid content (Mohan *et al.,* 2008) who reported that heating lag factor (J_h) of 1.44 and 1.0 for canned and pouch processed prawn kurma respectively. Cooling lag factor (J_c) of both pouches were 1.00 and 1.01 observed for the product and the results are similar was reported by Durance & Collins (1991). J_c values for convective heating products are reported to be close to 1, and for conducting heating packs, J*c* values could be much higher as the cooling process is much slower for these products. Jha *et al.,* (2011) reported similar values of J*c* for Dairy dessert kheer with lower total solid content.

The process time (B) was 10.52 min for non-transparent retort pouch whereas for 10.41 min for transparent pouches. The total process time, which includes 42 % of come up time**,** to process the products at Fo values of 3.95, and 3.8 were 14.60 and 13.97 minutes, respectively. Process time for products heated in conduction-heating regime are generally very long as compared to the ones observed in this study (Thijssen *et al.*, 1978). The reported values were lower than the one reported for conduction heating type products such as Soyabean paste, soyabean in brine and Dairy dessert Kheer (Guedez and Bath., 1975; Jha *et al*., 2011). The process time was slightly less for transparent pouch compare to that of non-transparent pouch. Though the thickness of these two pouches are same, the reduction in process time may be due to the presence of ALOxPET layer in the non-transparent pouch compare to nylon in the middle layer of transparent pouches.

Physico-chemical changes during storage

During storage study different parameters like pH, acidity, viscosity, specific gravity and instrumental colour measurements were studied at regular interval of 15 days once for a period of 3 months. The change in pH value for the rose flavoured milk in non-transparent and transparent pouches is shown in Table 3.

Table 3: Change in pH during storage of rose flavoured milk

Storage periods (in days)	**pH**	
	Non Transparent Retort pouch	**Transparent Retort pouch**
0	$6.66^{g} \pm 0.016$	$6.66^{g} \pm 0.018$
15	$6.62^{f} \pm 0.024$	$6.61^{f} \pm 0.006$
30	$6.58^{e} \pm 0.007$	$6.57^{e} \pm 0.008$
45	$6.55^{d} \pm 0.006$	$6.54^{d} \pm 0.006$
60	$6.52^{c} \pm 0.011$	$6.50^{c} \pm 0.008$
75	$6.48^{b} \pm 0.005$	$6.46^{b} \pm 0.009$
90	$6.44^{a} \pm 0.017$	$6.42^{a} \pm 0.023$

Table 4: Change in acidity during storage of rose flavoured milk

Storage periods (in days)	**Acidity**	
	Non Transparent Retort pouch	**Transparent Retort pouch**
0	$0.14^{a} \pm 0.004$	$0.14^{a} \pm 0.005$
15	$0.15^{a} \pm 0.005$	$0.15^{a} \pm 0.006$
30	$0.15^{ab} \pm 0.007$	$0.16^{ab} \pm 0.006$
45	$0.16^{abc} \pm 0.004$	$0.16^{abc} \pm 0.005$
60	$0.17^{cd} \pm 0.005$	$0.17^{bc} \pm 0.005$
75	$0.17^{bcd} \pm 0.004$	$0.17^{bc} \pm 0.008$
90	$0.18^{d} \pm 0.005$	$0.18^{c} \pm 0.004$

It was observed that pH of the rose flavoured milk showed a decreasing trend on storage in both pouches. There is no significant difference between non transparent and transparent pouches. The result of the pH are similar to the observation made by (Tekinsen *et al*., 2007) and in their study involving UHT

processing of milk. They reported that decrease in pH might be due to aggregations of casein micelles and formation of a gel. (Renner *et al*., 1981) reported that the reason for this drop in pH might be due to the interaction between lactose and milk protein. (Kocak *et al.*, 1985) showed that the storage temperature and time have a great effect on pH. Increase in acidity might be due to increase in concentration of lactic acid and other organic acids which resulted from degradation of lactose. Acidity of rose flavoured milk in both pouches increased slightly during storage shown in table 4.
The observed trend is similar to the one reported for UHT preserved milk (Dey, 2013; Akthar *et al.*, 2003). It was reported that the extent of proteolysis, age gelation, enzymatic activity and interaction of milk fat and milk protein might have an impact on the increase in viscosity of milk. The values for viscosity observed in this study were significantly different among different days of storage and showed an increasing trend Table 5.

Table 5: Change in viscosity during storage of rose flavored milk

Storage periods (in days)	**Viscosity**	
	Non Transparent Retort pouch	**Transparent Retort pouch**
0	$1.479^{a} \pm 0.003$	$1.480^{a} \pm 0.003$
15	$1.485^{b} \pm 0.002$	$1.486^{b} \pm 0.002$
30	$1.488^{c} \pm 0.001$	$1.490^{c} \pm 0.002$
45	$1.493^{d} \pm 0.001$	$1.494^{d} \pm 0.001$
60	$1.497^{e} \pm 0.002$	$1.499^{e} \pm 0.002$
75	$1.501^{f} \pm 0.001$	$1.503^{f} \pm 0.002$
90	$1.507^{g} \pm 0.002$	$1.507^{g} \pm 0.002$

However, the values were within the acceptable range of 1.5 to 2 centipoises even after 90 days of storage. The product was prepared with double toned milk and hence showed lower value of 1.4 to1.5. Comparison between transparent and non-transparent pouch showed that there is no significant difference in viscosity between them. The result of the viscosity observed in this study are similar to the one obtained for UHT treated milk (Akhtar *et al*., 2003; Ruiz and Richter, 1998; Kocak *et al*., 1985). There is no significant difference in the specific gravity of the product during the storage and among the type of packaging Table 6. However, specific gravity decreased for dietetic herbal flavoured milk during storage (Jothylingam and Pugazhenthi, 2013).

Table 6: Change in specific gravity during storage of rose flavoured milk

Storage periods (in days)	**Specific gravity**	
	Non Transparent Retort pouch	**Transparent Retort pouch**
0	1.035 ± 0.001	1.035 ± 0.002
15	1.035 ± 0.003	1.035 ± 0.003
30	1.036 ± 0.001	1.036 ± 0.003
45	1.036 ± 0.001	1.036 ± 0.002
60	1.036 ± 0.003	1.036 ± 0.004
75	1.036 ± 0.002	1.037 ± 0.001
90	1.037 ± 0.001	1.037 ± 0.003

Change in colour of rose flavoured milk during Storage
Analysis of colour data like L* (darkness to lightness), a*(redness to green),b* (blue to yellowness), hue and chroma of the rose flavoured milk was done and results are given in Table 7.

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Table 7: Effect of storage on hunter colour scores of rose flavored milk

Rose flavored milk										
Non-Transparent pouch						**Transparent retort pouch**				
Storage period (in days)	**Lightness (L*)**	**Redness (a*)**	**Yellowness (b*)**	**Hue**	**Chroma**	**Lightness (L*)**	**Redness (a*)**	**Yellowness (b*)**	**Hue**	**Chroma**
0	$96.13^{g}\pm0.01$	$8.17^{g}\pm0.01$	$22.44^{b}\pm1.51$	$70.50^{a}\pm0.01$	$22.82^{f}\pm0.01$	$96.21^{g}\pm0.01$	$7.62^{d}\pm0.01$	$21.52^{c}\pm0.01$	$70.50^{a}\pm0.01$	$21.22^{a}\pm0.01$
15	$96.02^{f}\pm0.01$	$8.07^{f}\pm0.02$	$20.83^{ab}\pm0.01$	$70.63^{ab}\pm0.12$	$22.70^{d}\pm0.01$	$96.7^{f}\pm0.01$	$7.51^{cd}\pm0.01$	$21.43^{bc}\pm0.01$	$70.68^{b}\pm0.01$	$22.70^{bc}\pm0.01$
30	$95.93^{e}\pm0.01$	$7.92^{e}\pm0.01$	$20.71^{a}\pm0.01$	$70.77^{b}\pm0.01$	$22.56^{c}\pm0.01$	$96.95^{e}\pm0.01$	$7.43^{bc}\pm0.01$	$21.31^{bc}\pm0.01$	$70.77^{c}\pm0.01$	$22.56^{bc}\pm0.01$
45	$95.81^{d}\pm0.01$	$7.80^{d}\pm0.01$	$20.58^{a}\pm0.01$	$71.00^{c}\pm0.01$	$22.39^{b}\pm0.01$	$95.87^{d}\pm0.01$	$7.29^{ab}\pm0.01$	$21.18^{b}\pm0.01$	$71.00^{d}\pm0.01$	$22.37^{b}\pm0.02$
60	$95.70^{c}\pm0.01$	$7.68^{c}\pm0.01$	$20.43^{a}\pm0.01$	$71.28^{d}\pm0.06$	$22.27^{b}\pm0.01$	$95.73^{c}\pm0.01$	$7.17^{a}\pm0.01$	$21.56^{b}\pm0.17$	$71.22^{e}\pm0.01$	$22.26^{b}\pm0.01$
75	$95.65^{b}\pm0.06$	$7.51^{b}\pm0.01$	$20.35^{a}\pm0.01$	$71.28^{d}\pm0.01$	$22.28^{b}\pm0.12$	$95.61^{b}\pm0.01$	$7.40^{bc}\pm0.13$	$20.82^{a}\pm0.16$	$71.28^{f}\pm0.01$	$22.18^{b}\pm0.08$
90	$95.42^{a}\pm0.01$	$7.43^{a}\pm0.90$	$20.12^{a}\pm0.01$	$71.20^{d}\pm0.01$	$21.93^{a}\pm0.01$	$95.48^{a}\pm0.01$	$7.22^{e}\pm0.01$	$20.82^{a}\pm0.01$	$71.60^{g}\pm0.01$	$23.15^{c}\pm0.52$

Table 8: Effect of storage on sensory score of badam flavored milk

Carrot flavored milk						
Non-Transparent pouch				**Transparent retort pouch**		
Storage Period (in days)	**Colour**	**Flavor**	**Overall acceptability**	**Colour**	**Flavor**	**Overall acceptability**
0	$8.94^{g\pm}$ 0.01	$8.95^{f}\pm 0.01$	$8.93^{f}\pm 0.01$	$8.92^{g}\pm 0.01$	$8.92^{g}\pm 0.00$	$8.97^{g}\pm 0.00$
15	$8.54^{f}\pm 0.01$	$8.53^{e}\pm 0.01$	$8.53^{e}\pm 0.01$	$8.52^{f}\pm 0.01$	$8.52^{f}\pm 0.01$	$8.54^{f}\pm 0.01$
30	$8.31^{e}\pm 0.01$	$8.34^{d}\pm 0.01$	$8.32^{d}\pm 0.01$	$8.30^{e}\pm 0.02$	$8.33^{e}\pm 0.01$	$8.29^{e}\pm 0.01$
45	$8.00^{d}\pm 0.01$	$8.01^{c}\pm 0.01$	$8.01^{c}\pm 0.01$	$8.09^{d}\pm 0.01$	$8.05^{d}\pm 0.01$	$8.07^{d}\pm 0.01$
60	$7.90^{c}\pm 0.01$	$7.92^{c}\pm 0.01$	$7.92^{c}\pm 0.00$	$7.88^{c}\pm 0.01$	$7.90^{c}\pm 0.01$	$7.91^{c}\pm 0.01$
75	$7.40^{b}\pm 0.01$	$7.41^{b}\pm 0.01$	$7.44^{b}\pm 0.01$	$7.39^{b}\pm 0.10$	$7.39^{b}\pm 0.01$	$7.39^{b}\pm 0.01$
90	$7.09^{a}\pm 0.02$	$7.08^{a}\pm 0.01$	$7.09^{a}\pm 0.01$	$7.08^{a}\pm 0.01$	$7.05^{a}\pm 0.01$	$7.07^{a}\pm$0 .10

In general the change in colour was in acceptable range throughout the storage period. However, slight decreasing trend and higher rate of decrement in transparent pouch of L value observed was similar to the study reported for UHT milk during exposure to light (Toba *et* al., 1980). It showed that the decreasing redness L* was due to getting darker during degradation of tryptophan. The observed decreasing trend of chroma may be due to Maillard's reactions, which start with binding of aldehyde group of lactose with amino group of the lysyl – residues (amino-acid radical, or residue of amino-acid lysine) from different milk proteins (Kneifel *et al.*, 1986). These reactions consist of a series of changes whose consequence is the formation of brown-colored pigments, such as pyralysins and melanoidins, polymers such as lactulose-lysine or fructose-lysine, as well as low-molecular weight acids. (Nielsen *et al*., 1997) stated that the positive value of yellowness b* indicated the precipitation of components of yellow b* colour of milk leading to the a decrease of the share of yellow colour in the milk powder on storage. The change of colour is probably induced by simultaneous degradation of the yellowish-green coloured riboflavin, β-carotene and vitamin A molecules (Neilsen *et al.*, 1997). The result of present study also agrees with the findings of (Raljic *et al*., 2008) who stated that the change in colour and its properties may be due to maillard reactions, increasing storage temperature and non-enzymatic spoilages.

Microbial study

All the samples were tested for commercial sterility and all of them are commercially sterile. In the microbial parameters viz. total viable count, anaerobic, coliform, yeast and mould for all three flavoured milk in both packaging were studied and they were absent on '0' day and as well as on '90' day of storage. Similar results were observed for UHT processed milk during 12 months storage period (Hassan *et al*., 2009).

Sensory analysis

Sensory evaluation of retort processed rose flavoured milk in non-transparent and transparent pouches was carried out at regular intervals of 15 days by 9 point hedonic scale (Table 8). The results of the study showed that overall acceptability of rose flavoured milk packed in non-transparent and transparent retort pouches were very good, with 8.97 and 8.96 initially. However, at the end of the storage period (90 days) the acceptability of non-transparent and transparent packed products reduced to 7.05 and 7.08 respectively under ambient storage conditions. Among other characteristics, colour had a minimum score of higher score of 8.94 and 8.92 initially and the same is reduced to 7.04 and 7.08 after 90 days of storage. No leakage, bad odour or any other spoilage was noticed in the pouches during 90 days of storage period.

Conclusion

Perceiving the potential of rose flavoured milk as a value-added dairy product in the international dairy market, ready-to- drink rose flavoured milk was developed by employing retort processing technology. The in-pouch-processed product had a shelf-life of 3 months without refrigeration. The physical properties of the pouch used were studied and found to meet the requirements as a container for foods processed in retort processing machine. Total process time (B value) for long-life rose flavoured milk in non-transparent and transparent retort pouches were 10.52 and 10.41 minutes and the standardized Fo values were 3.95 and 3.8 respectively. As the rose flavoured milk could be stored up to 3 months at ambient temperature without any appreciable loss in terms of physiochemical, microbiological and sensory attributes and could be used as a potential means of product diversification in the dairy industry.

REFERENCES

AOAC (2005). *Official Method of Analysis* (Association of Official Analytical Chemists) 16th edition (North Fredrick Avenue Gaithersburg, Maryland, USA) 481.

APHA (American Public Health Association),(1984). *Compendium of Methods for the Microbiological Examination of Foods* 2nd edition edited by ML Speck (American Public Health Association, Washington, DC).

Bindu J, Ravishankar CN and Srinivasa Gopal TK (2007). Shelf life evaluation of a ready-to-eat black cam (*Villorita cyprinoids*) Product in indigenous retort pouches. *Journal of Food Engineering* **78**(3) 995 1000.

Dey MH and Karim (2013). Study on physicochemical and microbial quality of available raw, pasteurized and UHT milk during preservation. *International Journal of Science Inventions Today* **2**(2) 150-157.

Durance TD and Collins LS (1991). Quality enhancement of sexually mature chum salmon *Onchorhynchus keta* in retort pouches. *Journal of Food Science* **56**(5) 1282–1286.

FDA (1983). Code of Federal Regulations. *Food and Drugs* **21** 170–199.

Gopakumar K and Gopal TKS (1987). Retort pouch packaging. *Packaging India* 3-4.

Gopal TKS, Vijayan PK, Balachandran KK, Madhavan P and Iyer TSG (2001). Traditional Kerala style fish curry in indigenous retort pouch. *Food Control* **12**(8) 523–527.

Gould WA, Geisman JR Weiser HH, Bash WD Moore WJ Salzer RH and Long FE (1962). Heat processing of vegetables in flexible films. *Ohio, Agricultural Experimental Station, Research Bulletin* 905

Griffin RC (1987). Retortable plastic packaging. In: *Modern Processing, Packaging and Distribution System of Food*, edited by FA Pain (AVI Publishing Co. Inc. West Port, CT) 1-19.

Guedez O and Bath RP (1975). A laboratory procedure for the pressure processing of flexible pouches. *Journal of Food Science* **40**(4) 724–727.

Hassan A, Imran A and Shahid M (2009). Microbiological and physicochemical analysis of different UHT milks available in market. *African Journal of Food Science* **3**(4) 100-106.

Horner WFA (1992). Canning fish Fish Processing Technology 114– 153.

Hu KH, Nelson A, Legault RR, and Steinberg MP (1955). Feasibility of using plastic film packages for heat processed foods. *Food Technology* **19**(9) 236-240.

IS: 2168. Specification for Pomfret Canned in Oil. Bureau of Indian Standards: New Delhi, 1971.

Jha A, Ashok AP, and Ravishankar C, Gopal TKS, Nagaraj Rao, (2011). Development of a process for manufacture of long-life dairy dessert kheer and its physico-chemical properties. *International Journal of Dairy Science* **64**(4) 591-597.

Jha Alok, Murli, Ashok Ambalal Patel and Teralandur Krishnaswamy Srinivasa Gopal (2012). Development of a process for shelf stable dairy dessert dalia and its physic-chemical properties. *Food Science and Technology* **49**(4) 80-88.

Jones MC (1968). Temperature dependence of the lethal rate in sterilization calculations. *Journal of Food Technology* **3**(1) 31–38.

Jothylingam S and Pugazhenthi (2013). Development of dietetic herbal flavoured milk and analysis for its physico-chemical properties. *International Journal of Food, Agriculture and Veterinary Science* **3**(1) 54-57.

Karel M, Fennema OR and Lund DB (1975). *Principles of Food Science* Part II (Marcel Dekker. New York, USA).

Kneifel W, Ulberth F and Schaffer E (1986). Tristymulus colour reflection measurement of milk and dairy products. *Lait*, **72** 383-391.

Kocak HR and Zadow JG (1985). Age gelatin of UHT whole milk as influenced by storage temperature. *Australian Journal of Dairy Technology* **14** 40.

Lampi RA (1980). Retort pouch: The development of a basic packaging concept in today's high technology era. *Food Processing Engineering* **4**(1) 1–18.

Manju S, Sonaji ER, Leema J, Srinivasa Gopal TK, Ravishankar CN and Vijayan PK (2004). Heat Penetration characteristics and shelf life studies of seer fish moily packed in retort pouch. *Fish Technology* **41**(1) 37–44.

Mohan CO, Ravishankar CN, Gopal TKS and Bindu J (2008). Thermal processing of prawn kuruma in retortable pouches and aluminium cans. *International Journal of Food Science and Technology* **43**(2) 200–207.

Nielsen B, Stapelfeldt H and Skibsted LH (1997). Differentiation Between 15 Whole Milk Powders in Rotation in Relation to Oxidative Stability During Accelerated Storage: Analysis of Variance and Canonical Variable Analysis. *International Dairy Journal* **7** 589-599.

Raljic, Nada S Lakic, Jovanka G Lalicic-Petronijevic, Miroljub B Barać 1 and Višnja M Sikimic (2008). Color Changes of UHT Milk During Storage. *Sensors* **8**(9) 5961-5974.

Ravishankar CN, Srinivasa gopal TK and Vijayan PK (2002). Studies on heat processing and storage of seer fish curry in retort pouches. *Packaging Technology and Science* **15**(1) 3–7.

Renner E and Schmidt R (1981). International Dairy Federation Bulletin, Doc. No 133. *Indian Journal of Dairy Science* **42**(2**)** 153.

Ruiz and Richter (1998). Changes in physic-chemical properties of retort sterilized dairy beverages during storage. *Journal of Dairy science* **81**(8) 2116-23.

Srivastava MK (2010). Milk Composition and Physico-chemical Properties. *Chemical & Microbiological Analysis of Liquid Milk* 22-35.

Stumbo CR (1973). *Thermobacteriology in Food Processing* 2nd edition (Academic Press Inc., New York) 329.

Tekinsen Kaan K, Mehmet Elmali and Zeynep Ulukanli (2007). Microbiological Quality of UHT Milk Consumed in Turkey. *International Journal of Food Safety* **7** 45-48.

Thijssen HAC, Kerkhof PJAM and Liefkens AAA (1978) Shortcut method for the calculation of sterilization conditions and optimum quality retention for conduction type heating of packaged foods. *Journal of Food Science* **43** (4) 1096–1101.

Toba T and Arai Adachi S (1980). Sunlight and sodium hypochlorite-induced colour changes in milk. *Journal of Dairy Science* **63** 1796-1801.

Vijayalakshmi NS, Sathish HS and Rangarao GCP (2003). Physico-chemical studies on indigenous aluminium foil based retort pouches vis-a` -vis their suitability for thermal processing. *Popular Plastics & Packaging* **48** 71–74.

Vijayalakshmi, N.S., Raj, B. & Murthy, R.A.N. (1992). Effect of one side and two-side exposure of plainm films on the amount of extractives into food simulants in migration tests. *Deutsche Lebensmittel Rundschau* **82**(4) 154–156.

Weintraub SE, Ramaswamy HS and Papke AM (1989). Heating rates in flexible packages containing entrapped air during overpressure processing. *Journal of Food Science* **54** 1417–1421.