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OPTIMIZATION PROCESS FOR THE DEVELOPMENT OF SOYMILK-BASED STRAWBERRY RTS BEVERAGES

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Abstract

Mostly all Indian are vegetarian and only depends on pulses for their protein need. Protein malnutrition mainly occurs in children and about 80% of children are suffering from malnutrition disorder. Thus soy-based products have become a good and attractive source as a potential alternative to cow's milk and also have high-quality proteins and carbohydrates but are devoid of lactose and cholesterol. It is an abundant and economical source of nutrition for milk allergy patients, lactose-intolerant individuals and also for the vegetarians. Soymilk based beverages can be taken as weaning food for babies and used as a treatment of malnourished children and when we use it's as a regular diet rich in iso-flavonoids that lowered the risk of many diseases, such as prostate and breast cancers, cardiovascular diseases and osteoporosis so we will be focus on both prospective but off-flavours of soymilk have been attributed to soybean, lipoxygenase (LOX) activity which restricts its use as a food component. Thus, the present investigation was carried out to reduce the beany flavour of soymilk and develop soy based strawberry rich beverage.

Keyword: Soymilk, RTS, Strawberry pulp, Lipoxygenase, Soybean and Cow milk.

Introduction

For the production of functional foods, production of non-dairy food products looks like a novel trend (Kano *et al*., 2002). The food products market has contained functional ingredients like prebiotics, probiotics, dietary fiber, soy, and derivatives grows approximately 5% per year worldwide and the selling of these products is to be over US$19.6 billion in 2013 (USDA, 2010). Soy-based products have become a good and attractive source as a potential alternative to cow's milk and also have high-quality proteins and carbohydrates but are devoid of lactose and cholesterol. It is an abundant and economical source of nutrition for milk allergy patients, lactose-intolerant individuals and also for the vegetarians (Granato *et al*., 2010a). Due to its undigested pepsin fraction, the soybean protein may affect the fecal excretion of bile acids or steroids and also influence the cholesterol metabolism (Romanchik-Cerpovicz *et al*., 2011). The consumption of soymilk contains high amounts of vitamin E and lecithin that is a natural functional food and increasing year by year. Soya milk and its derivatives are the cheapest sources of protein, its derivatives tofu (*soya paneer)* is using for making snacks and tasty dishes. The soybean milk i.e. prepared from soybean and can be compared with cow milk (Tomat *et al*., 2011). Soymilk closely resembles cow milk when it is correctly formulated, then use as an alternative to conventional milk (Lan *et al*., 1981). It is verified that the soymilk has a protective effect against age-related bone loss and other chronic diseases due to its non-steroidal phytoestrogen properties. When we use it's as a regular diet rich in iso-flavonoids that lowered the risk of many diseases, such as prostate and breast cancers, cardiovascular diseases and osteoporosis (Clarkson, 2002). Besides this iso-flavonoids have their anti-cancer, hormone altering, estrogenic and anti-estrogenic properties. Soybean has low saturated fat, therefore, is helpful in reducing coronary heart diseases. During the processing of soybean, it develops bitter taste due to the conversion of isoflavone glucosides to aglucone via the action of ß-glucosidases (Matsura *et al*., 1989). Currently, the protein calories malnutrition is widely spread in the country. Mostly all Indian are vegetarian and only depends on pulses for their protein need. Protein malnutrition mainly occurs in children and about 80% of children are suffering from malnutrition disorder. Hence, soymilk-based beverages can be taken as weaning food for babies and used as a treatment of malnourished children and also mask the beany flavor of soymilk, so we will be a focus on both perspectives. This is lactose and cholesterol free beverages.

Development of odor-free soya milk thereby necessitates suitable technological measures that are directed either minimizing the effect and role of lipoxygenase enzyme or incorporating suitable fruit flavor, spices or shredded edible greenly leaves and other essences that can mask the beany odor associated with soya milk for a better sensory acceptance. Addition of strawberry pulp in soymilk and strawberry is well-accepted fruit and liked by the consumer, it may improve the nutritional value of beverage. Soymilk based fruit juice beverage would offer several distinct nutritional advantages over the plain fruit beverage to the consumer. Addition of strawberry pulp to soymilk will enhance its vitamin C, B6, folate, riboflavin, manganese and omega-3 fatty acid content besides masking the beany flavor of soymilk.

Material and Methods

In present study soymilk: strawberry RTS beverages was prepared by using soymilk (*Glycine max)* and strawberry pulp (*Fragnaria ananassa*) in the Fruits and Vegetables Technology division, Defence Food Research Laboratory (DFRL), Mysore, India.

Raw Material: Raw materials such as soybean and strawberry for present investigation were purchased from local market, Mysore, India was washed with tap water to remove dirt and dust particle.

Preparation of Soymilk Beverages Blended with Strawberry Pulp: One kg of soybean was soaked in 3 kg of water (1:3) containing 5% of sodium bicarbonate (baking soda) and sodium carbonate for 12-16 hours. Hulls of the soybean were removed completely during washing. De-hulled soybean seeds were blanched for 15 minutes in boiled water in order to destroy lipoxygenase enzyme. The blanched seeds were drained and cooled it. Then blanched seed is ground in a blender with 1:7 ratio of water to form a paste and filter through a muslin cloth. The soymilk so prepared was heated to 100^0C for 30 minutes (Wang *et al*., 2001) and cooled at room temperature then added strawberry pulp (5-20%), after this adjusts the brix 15^0 by the addition of sugar. Then homogenization and pasteurization is taken place.

Standardization of Method for Preparation of soy-Strawberry Beverages: The standard combination of soymilk and strawberry pulp on the basis of their different levels such as 5%, 10%, 15% and 20% of strawberry pulp (*Fragnaria ananassa)* and 95%, 90%, 85%, and 80% soya milk were blended respectively. The required πbrix was altered (Choudhary *et al*., 2006) by adding sugar. Class-II preservatives such as potassium metabisulphite (150ppm) and sodium benzoate (150 ppm) were added.

Hydrothermally processed soy beverages were packed in standup packs after in-pack pasteurization at boiling water for 20 minutes and stored at ambient temperature (28±4ºC) for shelf stability. However, 20% strawberry pulp blended with 80 % soymilk was found 45 days shelf life compared to the other counterparts as evidenced by the physicochemical, sensory and microbiological characteristics. The TSS, moisture, protein, fat, sugars, acidity, pH, ascorbic acid, flavonoid content and total phenol and ash content of the soymilk, strawberry pulp, and soymilk based strawberry beverages were analyzed. The sensory qualities of RTS beverage like color and appearance, flavor, taste, mouth-feel and overall acceptability were evaluated by a semi-trained panel of 10 judges on 9 points Hedonic scale (1- extremely dislike, 9- extremely like) as suggested (Amerine *et al*., 1965) and values of scores in quadruplicate are reported.

Selection of dried beans
↓
Soaking in water at overnight
↓
Removal of skin
↓
Blanching (100^0C, for 15 minutes)
↓
Grinding with boiled water 60^0C (1:8)
↓
Addition of potassium metabisulphite (150 ppm)
↓
Filtration with a muslin cloth

Okra Soymilk
↓
Cooking at 100^0C (25-30 Minute)
↓
Addition of strawberry pulp
↓
Addition of sodium benzoate (150 ppm)
↓
Adjust Brix (15^0)
↓
Homogenization
↓
Packing in standing pouches
↓
Pasteurization at 80^0C for 30 min
↓
Storage

Flowchart for the Preparation of soymilk beverages blended with strawberry pulp

TSS (ºB)

Total soluble solids (TSS) of the soymilk, fruit pulp and soy-fruit beverage samples were measured by digital hand refractometer (0-50). The results were expressed as degree brix (°Brix) at 20°C (A.O.A.C. 1995).

pH

The pH of soymilk, strawberry pulp and soy-based beverages was determined by using a digital pH meter after standardizing with standard buffers of pH 4.0, 7.2 and 9.2.

Titratable Acidity

Titratable acidity of soymilk was estimated by titration method. In which known volume of the sample was titrated against standard sodium hydroxide solution using phenolphthalein as an indicator. The total titratable acidity was expressed as percent citric acid (Escueta and Banzon, 1979).

Color Measurement

The color parameters of soymilk-strawberry RTS beverages were measured using Hunter color meter (Mini scan XE plus, model 45/0-S Hunter laboratory Inc, Baton). The measurement was carried out at 10^0 observations, D65 illuminant source and instrument was calibrated using standard black and white tile provided by the manufacturer. The color values were expressed in CIE scale. L^* refers to lightness, $-a^*$ refers to greenness, and '-b' refers to blueness. a^* refers to redness and b^* refers to yellowness. The saturation index C* and hue angle h* was calculated using following equations

Saturation index: $C^* = (a^{*2}+b^{*2})^{0.5}$

hue angle: $h^* = \mathrm{Tan}^{-1}(b^*/a^*)$

Sensory Analysis

The sensory characteristics of the samples were analyzed in terms of consistency, taste, aroma, and color and reported an overall acceptability by the well trained ten panelists from DFRL. The organoleptic analysis was recorded in the sheet using 9 points hedonic scale in which 9 denotes liked extremely and 1 denotes disliked extremely as mentioned in the table 4.5.1 Samples were numbered randomly and served to the panel members in a noiseless room illuminated with white light and the temperature was maintained at 25^0C throughout the evaluation.

Statistical Analysis

The data obtained from physio-chemical analysis were subjected to analysis of variance (ANOVA) using completely randomized design (CRD) and least significant difference (LSD) at $P \leq 0.05$ using statistics 7.1 software (Stat Soft, Tulsa, OK, USA).

Result and Discussion

Proximate Composition of Soymilk and Strawberry Pulp

The soy extract was made with 1:7 dilution (soybean: water), because several authors and industrial processes report that this is the most frequently used method to formulations of soy-based beverage (SBB). The proximate composition of soymilk and strawberry are given in Table 1. The data revealed that the amount of pH, protein, moisture, fat, acidity, TSS, antioxidant, phenolics, flavonoid, total sugar and reducing sugar were 6.94, 4.91, 91.68, 2.65, 0.19, 2.96, 15.97, 6.72, 44, 1.4,0.46 respectively in soymilk whereas the pH, protein, moisture, fat, acidity, TSS, antioxidant, phenolics, flavonoid, anthocyanin, total sugar, reducing sugar, ascorbic acid in strawberry pulp were 3.13, 0.61, 91.75, 0.37, 0.832,7.17, 75.97, 28, 370, 376, 7.04, 1.21, 43 respectively.

Physico-chemical Properties of Soymilk-Strawberry RTS Beverages

The data on effect of strawberry pulp on nutritional constituents of soy based RTS beverage presented in Table 2, revealed that a standard RTS beverage prepared by blending of soymilk and strawberry pulp in the proportion 80:20 was found better with respect to the various physico-chemical constituents followed by 85:15, 90:10 and 95:5 combinations, respectively. Due to the increased in total sugars, reducing sugars, antioxidant and the ascorbic acid contents of 80:20 RTS beverages was significant than the other blends 85:15, 90:10 and 95:5 (Figure 1). This could be obviously due to increased amount of these constituent in strawberry pulp. The similar result was also reported (Wang *et al*., 1996).

Sensory Properties of Soymilk-Strawberry RTS Beverages

The sensory characteristics of the samples were analyzed in terms of consistency, taste, aroma, and color and reported as overall acceptability by the well trained ten panelists from DFRL. The overall sensory score indicated that soymilk-strawberry RTS beverages made from yellow soymilk with strawberry pulp (80:20) was best over all the other blends. This could be due to the strong flavour of strawberry pulp and soymilk was pleasant and strawberry pulp could effectively mask the 'beany flavour' of soymilk whereas in 95:5 inherent colour due to low concentration of strawberry pulp which degraded the visual appeal of the product which leads to its least acceptability. The result of changes in overall acceptability of soymilk-strawberry RTS beverages due to effect of different concentration of strawberry pulp is presented in Table 3.

The beverage prepared by adequate monitoring of soy milk and strawberry pulp leading to notified combinations were subjected to sensory evaluation to study the overall acceptability of product (Figure 2).

Changes in physicochemical parameter of soymilk-strawberry RTS beverages during ambient temperature storage

The storage stability of soymilk-strawberry RTS beverages was carried out at ambient temperature. It was found that pH, protein, moisture, fat, acidity, TSS, antioxidant, total phenolics, total flavonoids, anthocyanin, total sugar and reducing sugar changed during ambient temperature (28±4°C) storage.

Changes in pH of soymilk-strawberry RTS beverages during ambient temperature storage

The pH was found to decrease in all the five sample during ambient temperature (28±4°C) storage due to the increase in titrable acidity. The results are in agreement with the results obtained by Chaudhary *et al.* (2006) in guava RTS beverage (Messina, 1995). The results are also similar to the finding of D'sa and Andress (2006) in home canned peaches (D'sa and Andress 2006). From the first day to 45 days pH decreases slowly from 6.69 to 6.63 in control, 6.22 to 6.09 in 95:5, 5.58 to 5.46 in 90:10, 5.47 to 5.43 in 85:15 and5.13 to 5.06 in 80:20. Highest pH was recorded in control sample of first day (Figure 3).

Changes in acidity of soymilk-strawberry RTS beverages during ambient temperature storage

The acidity was found to decrease in all the five sample during ambient temperature (28±4°C) storage due to release of acid from the juice constituents. Similar findings were reported by Sogi and Singh 2001 in kinnow RTS beverage and Chaudhary *et al.* (2006). in guava RTS beverage. From the first day to 45 days acidity increases slowly from 0.19 to 0.27 in control, 0.31 to 0.40 in 95:5, 0.36 to 0.41 in 90:10, 0.41 to 0.47 in 85:15 and 0.47 to 0.53 in 80:20 (Figure 4). Highest acidity was found in 80:20 concentrations of 45 days.

Changes in ascorbic acid of soymilk-strawberry RTS beverages ambient temperature storage

The ascorbic acid was found to decrease in all the five sample during ambient temperature (28±4°C) storage due to oxidation caused by entrapped oxygen in stand-up pouches resulted in the formation of de hydro-ascorbic acid and storage temperature (Barwal *et al.*, 2002). From the first day to 45 days ascorbic acid decreases slowly from 1.67 to 1.62 in control 2.43 to 2.38 in 95:5, 3.23 to 3.18 in 90:10, 3.69 to 3.63 in 85:15 and 4.13 to 4.07 in 80:20. Sample 80:20 soymilk: strawberry RTS beverages of first day showed higher ascorbic acid content compared to other sample (Figure 5) due to lesser activity of sucrose in reactions leading to non-enzymatic browning.

Changes in reducing sugar of soymilk-strawberry RTS beverages during ambient temperature storage

From the first day to 45 days reducing sugar increase slowly from 4.6 to 4.7 in control, 4.73 to 4.76 in 95:5, 4.9 to 5.01in 90:10, 5.09 to 5.17 in 85:15 and 5.19 to 5.27 in 80:20. Sample 80:20 soymilk: strawberry RTS beverages of 45 days showed significantly higher reducing sugars than other sample due to inversion of sucrose (Figure 6). Fructose being reducing sugar of ketohexose might have contributed for higher reducing sugars. Least reducing sugar was found in control sample of first days. Since control sample of first day contain less sugar to contribute for reducing sugars. These results are in agreement with the findings of Barwal *et al.* (2002) in dietetic apricot squash.

Changes in total sugar of soymilk-strawberry RTS beverages during ambient temperature storage

The total sugar was found to decreases in all five sample during ambient temperature (28±4°C) storage due to reaction of sugars with amino acids (Barwal *et al.*, 2002). From the first day to 45 days total sugar decreased slowly from 14.03to 13.97 in control, 14.24 to 4.16 in 95:5, 14.27 to 14.19 in 90:10, 14.31 to 14.22 in 85:15 and 14.52 to 14.44 in 80:20. Sample 80:20 concentration of first day showed significantly higher total sugars (Figure 7).

Changes in anthocyanin of soymilk-strawberry RTS beverages during ambient temperature storage

From the first day to 45 days anthocyanin decreases slowly from 17.91 to 17.87 in 95:5, from 36.53 to 36.49 in 90:10, from 55.72 to 55.68 in 85:15, from 74.64 to 74.58 in 80:20. Sample 80:20 concentration of first day showed significantly higher anthocyanin (figure 8). Pelargonidin-3-glucoside is the most prevalent anthocyanin pigment which is responsible for red color of strawberry. Ayala-Zavala et al. reported a decreased in anthocyanin content when the strawberries were stored at 5°C.

Changes in total phenol of soymilk-strawberry RTS beverages during ambient temperature storage

From first day to 45 days phenol increases slowly from 6.72 to 6.74 in control, 9.71 to 9.76 in 95:5, 10.39 to 10.47 in 90:10, 21.64 to 21.69 in 85:15 and 27.81 to 28.41 in 80:20. 80:20 samples of 45 days showed significantly higher total phenol (Figure 9). Difference becomes statistically significant all the subsequent period of storage under consideration. Total phenol increased in all sample during storage at ambient temperature, which may be attributed to the hydrolysis of the tannins which are reported to be dominant in strawberries.

Changes in antioxidant of soymilk-strawberry RTS beverages during ambient temperature storage

The antioxidant was found to decreases in all the five sample during ambient temperature (28±4^{0}C) storage. From the first day to 45 days antioxidant increases slowly from 23.01 to 23.04 in control, 42.09 to 42.13 in 95:5, 51.03 to 51.05 in 90:10, 68.06 to 68.09 in 85:15 and 71.01 to 71.04 in 80:20. 80:20 samples of 45 days showed significantly higher antioxidant (figure 10). Storage period had a significant effect on the antioxidant activity exhibited by DPPH assay.

Changes in total flavonoid of soymilk-strawberry RTS beverages during ambient temperature storage

From the first day to 45 days flavonoid increases slowly from 19.62 to 19.72 in control, from 44.76 to 44.80 in 95:5, from 72.69 to 72.80 in 90:10, from 81.87 to 82.00 in 85:15, from 120.45 to 120.74 in 80:20. 80:20 samples of 45 days showed significantly higher total flavonoid (Figure 11). Difference becomes statistically significant all the subsequent period of storage under consideration.

CIE* value soymilk-strawberry RTS beverages

Table 4 showed the colour changed due to effect of different concentration of strawberry pulp was analysed on the parameter such as lightness (L*), green–red chromaticity (a*), and blue-yellow chromaticity (b*) of soymilk-strawberry RTS beverages. L*values of control sample were significantly higher than the other sample. A higher L* value indicates a lighter color.

The a* values were significantly higher for 80:20 concentration. The blue–yellow chromatically (b*) values were also significantly higher for control concentration soymilk. Visual observation confirmed the results obtained with the hunter color lab, since the 80:20 sample were darker, more red, and yellowish than other.

Conclusion

It can be concluded that soymilk can be found that soymilk and strawberry pulp in the proportion 80:20 was found better with respect to the various physico-chemical constituents followed by 85:15, 90:10 and 95:5 combinations, respectively. The increase in total sugars, reducing sugars, antioxidant and the ascorbic acid contents in the blend of soy milk and strawberry pulp RTS at 80:20 was significant than the other blends 85:15, 90:10 and 95:5. This could be obviously due to increased amount of these constituent in strawberry pulp. The CIE* values of soymilk: strawberry beverages showed best results in the case of 80:20 when measured in terms of lightness (L*), redness/greenness (a*) and yellowness/blueness (b*). Development of odor free soy beverages with strong fruit flavor of strawberry is in great demand due to lactose intolerance and cholesterol free nature of soy products. The variously formulated strawberry blended soy-based beverages was also found highly quench thrusting effect and proteinaceous and sensory parameter. The technology of soymilk: strawberry RTS beverages were found cost effective and suitable for small scale industries for the production.

Table 1 : Proximate composition of soymilk and strawberry pulp

Parameters	Soymilk	Strawberry pulp
pH	6.94±0.02	3.13±0.05
Protein (g)	4.91±0.17	0.61±0.21
Moisture (%)	91.68±0.12	91.75±0.13
Fat (%)	2.65±0.19	0.37±0.17
Acidity (%)	0.19±0.01	0.832±0.03
TSS(^{0}Brix)	2.96±0.73	7.17±0.02
Antioxidant (mg/100g)	15.97±0.64	75.97±0.64
Phenolics (mg of gallic acid eq./100)	6.72±0.09	28±0.05
Flavonoid (mg of catechol eq./100g)	44±0.64	370±0.76
Anthocyanin (mg/100g)	---	376±0.08
Total sugar (%)	1.4±0.12	7.04±0.13
Reducing sugar (%)	0.46±0.13	1.21±0.07
Ascorbic acid (mg/100g)	--	43±0.03

Mean ±SD (n=3)

*value with different superscripts in a column differ significantly ($p<0.05$)

Table 2 : Physico-chemical properties of soymilk-strawberry RTS beverages

Beverages (Strawberry:Soymilk)	pH	Acidity (%)	Brix^{0}	Anthocyanin (mg/100g)	Total sugar (%)	Reducing Sugar (%)	Antioxidant (mg/ 100g)	Total phenolic (mg of Gallic eq./100)	Total Flavonoid (mg of Catechin eq./100g)
Control	6.69±0.07^{a}	0.19±0.7^{a}	15±0^{a}	0	14.03±0.72^{a}	4.58±0.08^{a}	23.01±0.04^{a}	6.72±0.02^{a}	19.62±0.07^{a}
5:95	6.22±0.08^{b}	0.31±0.07^{b}	15±0^{a}	17.91±0.05^{a}	14.24±0.12^{b}	4.67±0.01^{b}	42.09±0.03^{b}	9.71±0.01^{b}	44.76±0.07^{b}
10:90	5.58±0.04^{c}	0.36±0.05^{c}	15±0^{a}	36.53±0.04^{b}	14.27±0.24^{b}	4.89±0.05^{c}	51.03±0.04^{c}	10.39±0.04^{c}	72.69±0.06^{c}
15:85	5.47±0.04^{d}	0.41±0.03^{d}	15±0^{a}	55.72±0.02^{c}	14.31±0.28^{c}	5.02±0.06^{d}	68.06±0.02^{d}	21.64±0.07^{d}	81.87±0.04^{d}
20:80	5.13±0.02^{e}	0.47±0.01^{e}	15±0^{a}	74.64±0.09^{d}	14.52±0.09^{d}	5.11±0.02^{e}	71.02±0.07^{e}	27.81±0.01^{e}	120.45±0.03^{e}

Mean (n=3) ±SD *value with different superscripts in a column differ significantly ($p<0.05$)

Table 3 : Effect of strawberry pulp on nutritional constituents of soy based RTS beverage

Beverages (Strawberry : Soymilk)	Color	Flavor	Aroma	Consistency	Overall acceptability
control	6.53±0.09^{a}	6.62±0.07^{a}	6.86±0.09^{a}	6.72±0.09^{a}	6.96±0.05^{a}
5:95	6.75±0.06^{b}	6.83±0.0.8^{b}	6.97±0.07^{b}	6.85±0.01^{b}	7.08±0.02^{b}
10:90	6.93±0.09^{c}	7.61±0.06^{c}	7.08±0.03^{c}	6.96±0.05^{c}	7.57±0.06^{c}
15:85	7.81±0.07^{d}	7.74±0.09^{d}	7.53±0.07^{d}	7.28±0.02^{d}	7.79±0.06^{d}
20:80	8.25±0.05^{e}	8.62±0.06^{e}	7.86±0.05^{e}	7.45±0.06^{e}	8.23±0.07^{e}

Mean (n=3) ±SD *value with different superscripts in a column differ significantly ($p<0.05$)

Table 4 : Changes in CIE* value soymilk-strawberry RTS beverages

Beverages (Strawberry :Soymilk)	L*	A*	B*
control	52.11	0.05	5.11
5:95	48.29	0.87	4.82
10:90	46.12	1.63	3.57
15:85	44.23	2.19	3.07
20:80	38.32	3.28	1.25

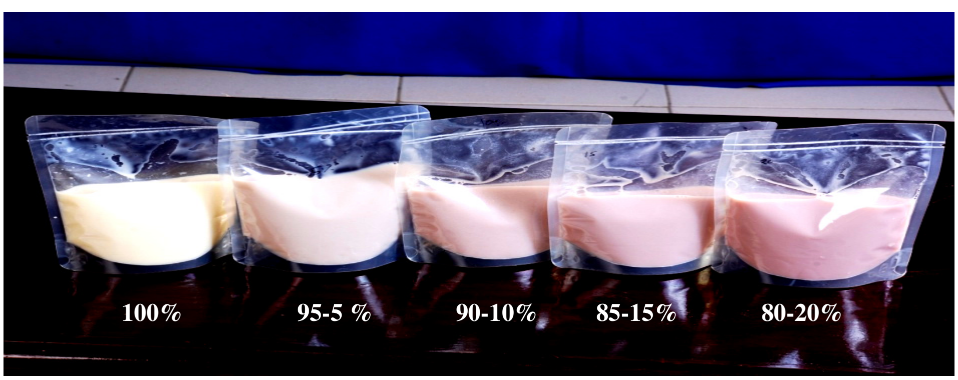

Fig. 1 : Different concentrations of soymilk-strawberry RTS beverages

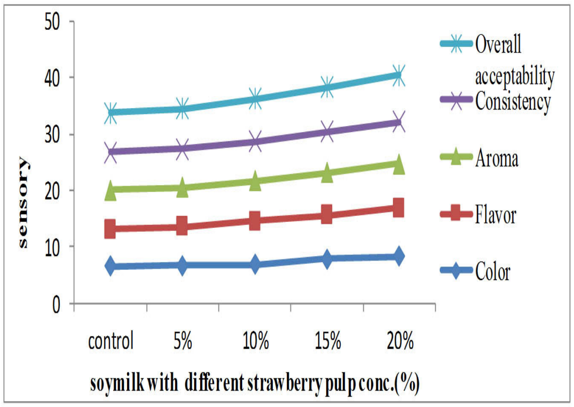

Fig. 2 : The sensory evaluations of soymilk-strawberry RTS beverages

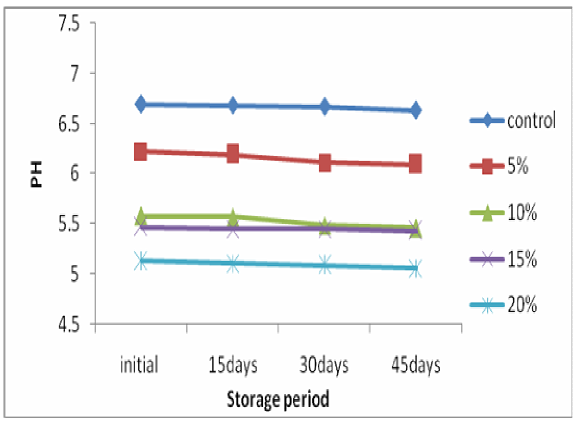

Fig. 3 : Changes in pH of soymilk-strawberry RTS beverages

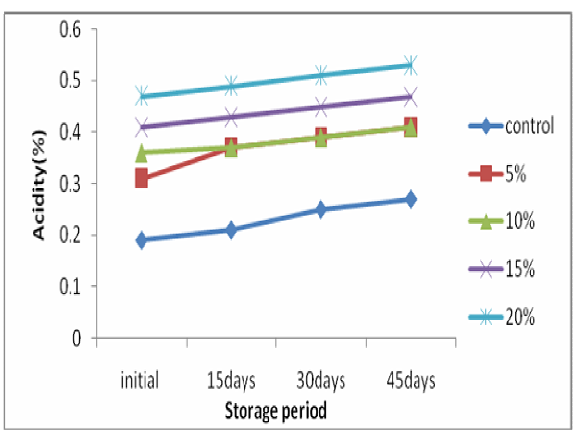

Fig. 4 : Changes in acidity of soymilk-strawberry RTS beverages

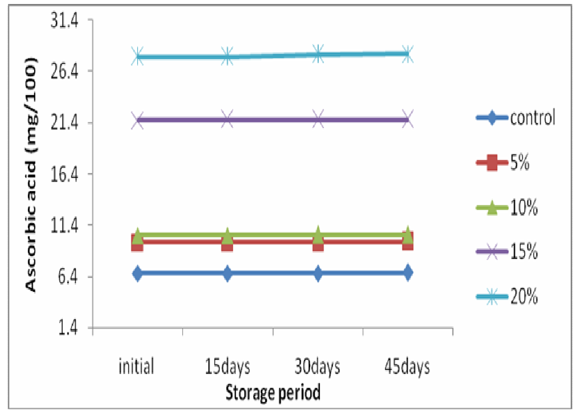

Fig. 5 : Changes in ascorbic acid of soymilk-strawberry RTS beverages

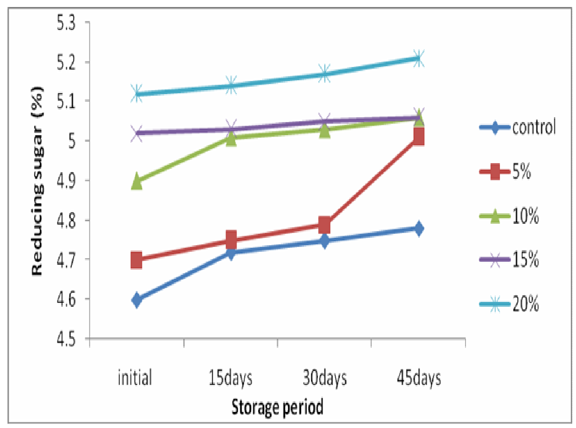

Fig. 6 : Changes in reducing sugar of soymilk-strawberry RTS beverages

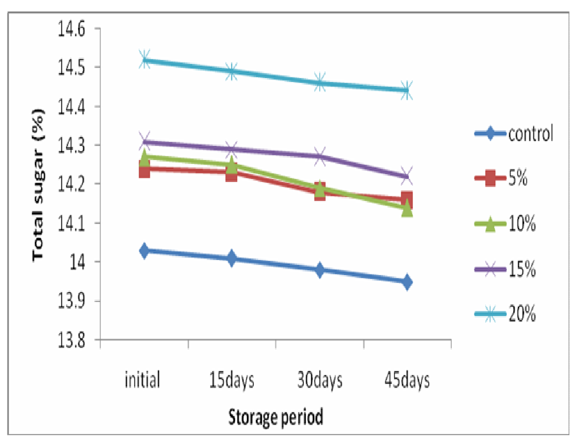

Fig. 7 : Changes in total sugar of soymilk-strawberry RTS beverages

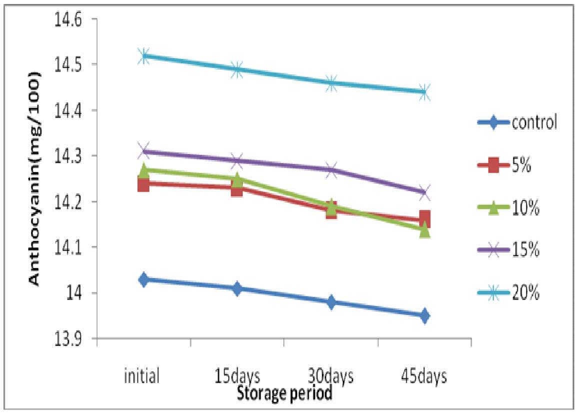

Fig. 1 : Changes in anthocyanin of soymilk-strawberry RTS beverages

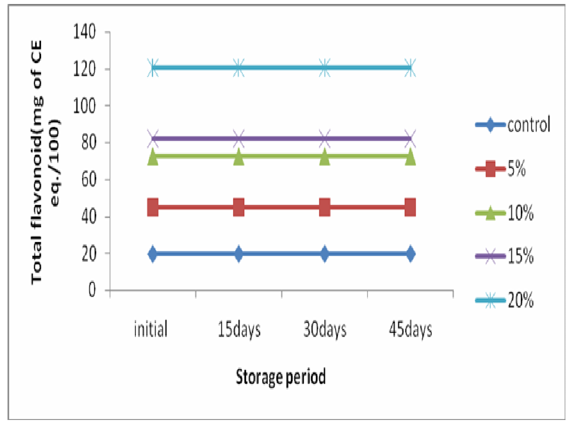

Fig. 11 : Changes in total flavonoid of soymilk-strawberry RTS beverages

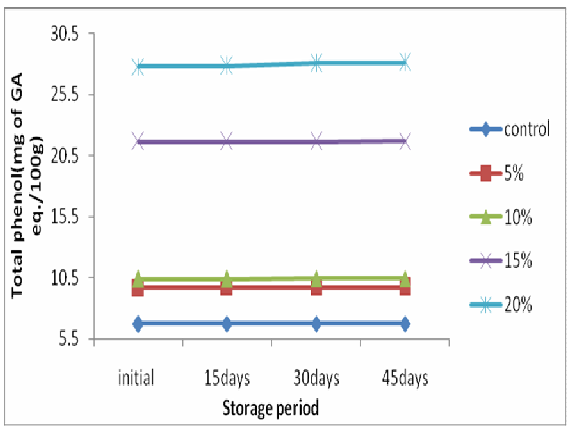

Fig. 2 : Changes in total phenol of soymilk-strawberry RTS beverages

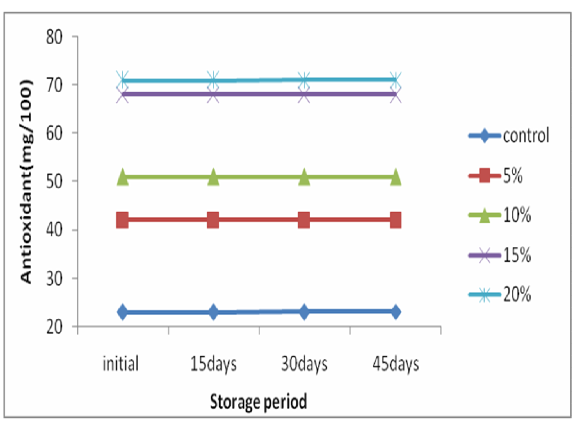

Fig. 3 : Changes in antioxidant of soymilk-strawberry RTS beverages

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