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Research Article
Characteristics of White Soft Cheese Fortified with Hibiscus Soft Drink as Antimicrobial and Hypertension Treatment

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Abstract

Objective: This study was carried out to use hibiscus soft drink as antimicrobial and hypertension treatment on the characteristics and quality of white soft cheese. **Methodology:** Functional white soft cheese was manufactured from UF retentate containing hibiscus soft drink at ratios of 0, 2, 4, 6, 8 and 10%. Hibiscus soft drinks were prepared by two methods: Soaking and blanching. Characteristics of white soft cheese resultant were assessment. **Results:** Cheese colour parameters (L*, a*, b*, ΔE, A_{420nm}, C*, H* and BI) were clear increased in cheese samples containing blanching hibiscus soft drink than that containing soaking hibiscus soft drink. Total solid, protein, fat and pH values were decreased with increase hibiscus extract ratio. Hardness of cheese was decreased from 11.80 g in the control sample to 2.10 g in the treatment containing 10% of soaking hibiscus soft drink. Gumminess and chewiness decreased from 8.72 g and 7.41g mm^{-1} in the control samples to 1.34 g and 0.89 g mm^{-1} in that treatment containing 10% soaking hibiscus soft drink, respectively. Cheese containing blanching hibiscus soft drink showed low hardness values reached to 1.80 g with 10% blanching hibiscus soft drink. Gumminess and chewiness of blanching hibiscus soft drink cheese appeared lowest values compared to that containing soaking hibiscus soft drink. Results indicated that the anthocyanine assessment (Polymeric Colour (PC), colour density (TCD), tannin contributions (CDT) and concentration of total anthocyanins (TACN)) were lower in blanching hibiscus cheese samples than that with soaking hibiscus cheese samples. Cheese colour was acceptable of that containing up to 6% soaking or blanching hibiscus soft drink while that containing more hibiscus soft drink was rejected by scoring persons. Cheese containing soaking or blanching hibiscus percent up to 4% had gained more score and more acceptability than that containing higher percent of hibiscus soft drink compared to control sample. Total plate count, yeast and mould counts were lower in blanching hibiscus cheese samples than that found in soaking hibiscus cheese compared to the control cheese samples. **Conclusion:** These results support that the application of hibiscus soft drink addition as an antimicrobial activity (food preservation technique) and hypertension treatment in white soft cheese that can be explored commercially to benefit for both the producers and consumers.

Key words: White soft cheese, hibiscus extract, texture properties, cheese colour, anthocyanines, antimicrobial effect

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Cheese is a dairy product that has played a key role in human nutrition for centuries. White soft cheese is the most popular varieties of cheese available in large quantities on the markets of Egypt. The main objective has always been and still is to convert milk into a product with a longer shelf life whilst preserving most of its nutrients[1].

Today's, the current consumer's interest towards functional products that contributeto decrease risks of diseases so, there is a growing market for foods containing probiotic bacteria and sales have increased from 7-32% each year as a function of products and geographical regions[2]. Recently, consumers expect their food to be healthy and to prevent illness as they are increasingly interested in their personal health[3]. Many documents tries to clarify the improving quality of white cheese using different additives like lime and grape fruit[4], cinnamon and thyme[5], cranberry fruit extract[6], lupin milk[7] and soy protein[8].

Hibiscus (*Hibiscus sabdariffa*) is originally cultivated throughout tropical and subtropical regions, especially in Egypt, Sudan, Thailand and China. Hibiscus also is known as karkade, red tea, red sorrel, Jamaica sorrel, rosella, soborodo (Zobo drink), karkadi, roselle and sour tea[9,10]. The karkade flowers provide a soft drink, highly appreciated all over the world for the particular sensation of freshness conveyed. Karkade based products are used in popular medicine to obtain an anti-hypertensive effect[11] as well as to prevent cardiovascular and hepatic diseases. Also, hibiscus petals are potentially a good source of antioxidant agents as anthocyanins and ascorbic acid[12]. Hibiscus Anthocyanins (HAs) is a group of natural pigments occurring in the dried flowers which is a local beverage material and medical herb[13]. Chen *et al.*[14] showed that the karkade` may be effective against low-density lipoprotein oxidation and hyperlipidemia. Moreover, soaked hibiscus in water (cold extraction) isable to preserve vitamin C of hibiscus, which is a useful partner of polyphenols in their angio-protective activity. Polyphenols are general constituents of plant-derived foods such as hibiscus and are the principal antioxidant in the human diet. They show a variety of biochemical activities, including antioxidant, apoptosis, antiaging, anticancer, anti-inflammation, anti-atherosclerosis, cardiovascular protection and endothelial function enhancing activities, as well as angiogenesis inhibition and cell proliferation activities[15].

Also, hibiscus pigments may play a role in the prevention of oxidative damage in living systems. However, anthocyanin and Polymeric Colour Anthocyanine (PCA) have been shown to have antioxidant activity and to offer protection against atherosclerosis and cancer[16], DNA is avital molecule in the cell activities and was the main target for chemicals induced cell injury. The commercial pigment or colouring agent has been implicated in several clinical conditions but most experimental work has concentrated on childhood hyperactivity, articaria, asthma[17].

The purpose of this study is conducted to identify the effect of hibiscus soft drink as antimicrobial and hypertension treatment onthe characteristics and quality of white soft cheese.

MATERIALS AND METHODS

Plant material and hibiscus soft drink preparation: Fresh calyces of *Hibiscus sabdariffa* Linn. (Malvaceae) was purchased from the Ministry of Agriculture, Egypt and shade-dried under sunny conditions at ambient temperatures. The dried *Hibiscus sabdariffa* calices were ready to use in produce of traditional hibiscus flower soft drink or beverage.

Hibiscus soft drink preparation

Blanching-hibiscus soft drink: A decoction of blanching-hibiscus flower soft drink was prepared as follow: Boiling 50 g of dried calyces of *Hibiscus sabdariffa* Linn., at 100°C for 5 min with about 1000 mL of distilled water and then rapidly filtered through a Buchner funnel and filled according to the calibrated volume glass bottles (1000 mL). This material (50 g) was extracted twice with water for 5 min at 100°C and the extract then was re-dissolved in 1 L of drinkable water. The traditional blanching hibiscus drink was stored at refrigerator temperature (4°C) until used[10].

Soaking-hibiscus soft drink: A decoction of soaking hibiscus flower soft drink was prepared as follow: Soaking 50 g of dried calyces of *Hibiscus sabdariffa* Linn. in about 1000 mL of distilled water at room temperature 25°C for 12 h and each extract was rapidly filtered through a Buchner funnel and filled according to the calibrated volume glass bottles (1000 mL). The traditional soaking hibiscus soft drink was stored at refrigerator temperature (4°C) until used[10].

White soft cheese manufacture: Milk retentate was obtained from Dairy Industry Unit, Animal Production Research Institute, Ministry of Agriculture, Dokki, Cairo, Egypt. The average chemical composition of milk retentate was:

Total solids	=	32.44%
Proteins	=	13.76%
Fat	=	14.00%
Lactose	=	4.10%
pH	=	6.80

Table 1: Hibiscus ratios fortified to the retentate

Ratios/Treatments	Retentate ratio	Hibiscus soft drink ratio	Total
Control	100	0	100
1	98	2	100
2	96	4	100
3	94	6	100
4	92	8	100
5	90	10	100

Cheese manufacture: Milk retentate was salted at ratio of 3% with sodium chloride (NaCl). Salted retentate was heated to 72°C for 15 sec and then cooled immediately to 43°C. The retentate was divided to several portions to fortify it with hibiscus soft drink according to the following ratios, as seen in Table 1.

Cheese manufacture was done according to that described by Foda *et al.*[18]. Previous prepared milk retentate were renneting at about 42°C and then poured at plastic cups, incubating for 30 min to complete coagulation. After coagulation all treatments were kept in refrigerator 5°C±2. All treatments were replicate 3 times.

Methods of analysis: The cheese samples were analysed for moisture and fat as described by AOAC[19]. Total nitrogen as described in IDF standard[20]. Lactose was determined according to Barnett and Tawab[21]. The pH value was measured using a laboratory pH meter with glass electrode.

Texture profile of white soft cheese: The Texture Profile Analysis (TPA) of white soft cheese was performed using multi test 1-d texture analyzer, mecmesin limited, Slinfold, West Sussex, UK according to the method of El-Aziz *et al.*[22]. Experiments were carried out by a compression test that generated a plot of force (N) versus time (sec). Samples were double compressed at a compression speed of 2 cm min^{-1}. The analysis was carried out at 10°C. Hardness (g), springiness (mm), chewiness (g mm^{-1}), gumminess (g) and cohesiveness were calculated from the obtained TPA according to the definition given by the International Dairy Federation (IDF)[23].

Colour characteristics and parameters determinations: Hunter a*, b* and L* parameters were measured with a colour difference meter or the colour of white soft cheese fortified with different ratios of soaked and blanched hibiscus soft drink was measured using a spectro-colourimeter (Tristimulus colour machine) with the CIE lab., colour scale (Hunter, Lab., Scan XE-reston VA, USA) in the reflection mode. The instrument was standardized each time with white tile of Hunter Lab., colour standard (LX No. 16379): X = 72.26, Y = 81.94 and Z= 88.14 (L* = 92.46, a*= -0.86, b* = -0.16)[24]. Colour difference, delta E was calculated from a*, b* and L* parameters, using Hunter-Scotfield's equation[25]as follows:

Delta E = (delta a2+delta b2+delta L2)1/2

where, a-ao, b-bo and L-Lo; "o" indicates colour of control or untreated sample.

The Hue (H)*, Chroma (C)* and Browning Index (BI) was calculated according to the method of Palou *et al.*[26] as follows:

$$H^* = \tan\text{-}1\ \frac{b^*}{a^*} \quad (1)$$

$$C^* = \text{Square root of } [a2^*+b2^*] \quad (2)$$

$$BI = [100\ (x\text{-}0.31)]\ 10.72 \quad (3)$$

Where:

$$X = \frac{(a^*+1.75L^*)}{(5.645L^*+a^*-3.012b^*)}$$

Pigment and anthocyanin analyses: Polymeric Colour (PC), colour density (TCD) and tannin contributions (CDT) were determined using spectral methods described by Spayd *et al.*[27]. For Total Colour Density (TCD), a 2 mL sample was diluted 2 mL distilled water and absorbance 420, 515 (at the absorbance maximum) and 700 nm on the spectrophotometer. The TCD was calculated as follows:

$$TCD = (A_{42}0+A_{515})\text{-}2\ (A_{700}) \quad (4)$$

For Polymeric Colour (PC), a 2 mL sample was treated with 2 mL 20% K2S2O5. Samples were held 1 h at 20°C under commercial light prior to measurement of absorbance 420, 515 and 700 nm. Polymeric colour was calculated as follows:

$$PC = (A_{420}+A_{515})\text{-}2(A_{700}) \quad (5)$$

Percent of colour due to tannin (% CDT) was calculated as:

$$CDT\ (\%) = \frac{PC}{TCD}\times 100 \quad (6)$$

Concentration of total anthocyanins (TACN) was determined by the pH differential method as described by Wrolstad[28]. Absorbance was measured in the spectrophotometer at 515 and at 700 nm in buffer pH 1.00 and pH 4.50, using A = (A_{515}-A_{700}) pH 1.00-(A_{515}-A_{700}) pH 4.50. Results were expressed as milligrams of cyanidin-3-glucoside equivalent per liter of fresh weight using an extinction coefficient of 29600 and molecular weight of 445.2 g mol^{-1}.

Microbiological evaluation: White soft cheese fortified with different ratios of soaked and blanched hibiscus soft drink was determined in triplicate for total aerobic bacteria and yeast and moulds according to FDA[29]. Untreated and treated samples were serially diluted with 0.1% peptone (DIFCO Labs., Detroit, MI) and pour-plated in duplicate. Total aerobic bacteria counts: One milliliter aliquot of each sample was plated using a plate count agar medium (Merck KGaA, Darmstadt, Germany) and incubated at 35-37°C for 48 h to counting. Yeast and moulds (Y and M) were determined using malt extract agar (Merck KGaA, Darmstadt, Germany) after incubation at 25°C for 3 days. The number of colonies (total aerobic bacteria or yeast and moulds) that appeared on the plates was counted and expressed as log colony forming unit per milliliter or log CFU mL^{-1}.

Sensory evaluation: The UF soft cheese fortified with hibiscus soft drink were scored for organoleptic properties by a taste panel of 15 persons for National Research Centre staff as described by Ismail[30]. The panelists scored the cheese flavour (out of 50 points), body and texture (out of 35points) and appearance and colour (out of 15 points).

Statistical analysis: Mean values from the three separate experiments or replicate analysis were reported. The obtained results were analyzed statistically using Standard Deviations (n = 3) and average as described by Richard and Gouri[31].

RESULTS AND DISCUSSION

Chemical composition: Table 2 shows the chemical composition of fresh white soft cheese fortified with different ratios of soaked or blanched hibiscus soft drink. Total solids, protein and fat contents were decreased with increase the ratio of hibiscus soft drink fortification. These decrease due to decrease of hibiscus soft drink total solid contents. Also, pHs decreased from 6.80 in the control sample to 5.87 of that containing 10% soaked hibiscus soft drink. The pHs continued to more decrease from 6.62-5.76 with blanched hibiscus soft drink in the same order. This can be attributed to the acidity of hibiscus soft drink fortification used.

Texture profile: The data measured by the texture analyzer are shown in Table 3. Hardness of the hibiscus cheese samples decreased with the increasing the ratio of hibiscus fortification. Hardness of control sample appeared hardness of 11.80 g decreased to 8.20 g with that fortified 2% soaked hibiscus soft drink and decreased sharply to 2.10 g with 10 soaked hibiscus soft drink while the cheese fortified with blanched hibiscus soft drink showed more lower hardness of 7.20 g with 2% blanched hibiscus soft drink and reached to 1.80 g with that contain 10% blanched hibiscus soft drink. Approximately, no differences in the springiness or cohesiveness of cheese fortified with 2 or 4% soaked hibiscus soft drink. Gumminess or chewiness of cheese samples decreased with increasing the ratios of hibiscus soft drink. Cheese fortified with blanched hibiscus soft drink appeared lower values of gumminess and chewiness of 5.54 g and 3.98 g mm^{-1} at 2% fortification which decreased to 2.22 g and 1.89 g mm^{-1} at 4% fortification and reached to 1.19 g and 0.83 g mm^{-1} at 10% fortification compared to that cheese fortified with soaked hibiscus soft drink. The results clear that the cheese fortification by soaked or blanched hibiscus soft drink led to decrease of cheese texture parameters values.

Table 2: Chemical composition of white soft cheese fortified with soaked and blanched hibiscus soft drink

Test/Treatment	pH	TS	TP	Fat
Soaked hibiscus soft drink				
Control	6.80	35.66	13.95	14.2
1	6.50	35.04	13.46	13.5
2	6.31	34.29	12.54	12.7
3	6.11	33.86	12.12	12.2
4	5.95	33.22	11.76	12.0
5	5.87	32.79	11.31	11.5
Blanched hibiscus soft drink				
Control	6.62	35.34	13.11	13.2
1	6.36	36.06	11.97	12.0
2	6.16	34.07	11.24	11.5
3	5.93	33.22	11.03	11.2
4	5.71	32.90	10.55	11.0
5	5.67	32.10	10.03	10.5

TS: Total solid, TP: Total protein

Table 3: Textural properties of white soft cheese fortified with soaked and blanched hibiscus soft drink

Test/Treatment (%)	Hardness (g)	Springiness (mm)	Cohesiveness	Gumminess (g)	Chewiness (g mm^{-1})
Soaked hibiscus soft drink					
Control	11.80	0.85	0.76	8.72	7.41
1	8.20	0.78	0.76	6.27	4.89
2	3.90	0.78	0.74	2.96	2.31
3	3.10	0.68	0.56	1.74	1.18
4	3.30	0.68	0.60	1.99	1.36
5	2.10	0.66	0.64	1.34	0.89
Blanched hibiscus soft drink					
Control	10.00	0.80	0.81	7.62	6.63
1	7.20	0.75	0.79	5.54	3.98
2	3.00	0.70	0.74	2.22	1.89
3	2.40	0.65	0.70	1.68	1.43
4	2.10	0.65	0.67	1.41	0.99
5	1.80	0.60	0.60	1.19	0.83

Colour characteristics, pigment and anthocyanin contents of white soft cheese fortified with traditional blanching and soaking hibiscus soft drink: Colour is only part of the overall

Table 4: Colour characteristics of white soft cheese fortified with hibiscus soft drink

Ratios/Treatments	L*	a*	b*	ΔE	$A_{420\,nm}$	C*	H*	BI
Cheese with soaked hibiscus soft drink								
Control	85.50	-1.24	16.45	83.23	47.75	16.50	85.69	21.74
1	72.81	-0.16	10.58	78.34	28.00	10.58	85.43	18.17
2	70.64	0.76	9.28	75.84	25.77	9.31	85.32	18.80
3	66.97	1.72	8.57	73.60	21.51	8.74	78.65	21.14
4	59.58	2.82	8.36	71.27	13.27	8.82	71.36	26.80
5	60.57	3.25	8.64	70.15	10.02	9.23	69.39	28.31
Cheese with blanching hibiscus soft drink								
Control	88.96	-0.48	13.57	14.17	57.57	13.58	87.97	18.49
1	79.73	1.11	10.15	16.56	44.29	10.21	83.76	18.87
2	75.65	1.73	9.78	19.76	38.02	9.94	79.97	20.78
3	64.12	3.12	9.80	30.36	16.24	10.28	72.34	28.63
4	66.97	3.73	11.25	28.38	25.50	11.85	71.66	31.90
5	56.67	5.05	11.26	38.11	24.04	12.34	65.84	42.37

L*: Brightness, a*: Redness, b*: Yellowness, ΔE: Delta E, C*: Chroma, H*: Hue and BI: Browing index

appearance but is probably a major quality factor in cheese and soft drink products. Colour characteristics measurement directly in the cheese fortified with soft drink samples with a Hunter Lab., Ultra Scan revealed that colour changed in cheese fortified with traditional blanching and soaking hibiscus soft drink sample (Table 4). In this case, brightness (L*-values) decreased, redness (a*-values) increased and yellowness (b*-values) decreased. However, anthocyanin loss can be easily determined by pigment, colour analysis and also tristimulus colourimetry. Tristimulus colourimetry in colour is a valuable tool for discriminating changes in colour due to both Milard reaction and anthocyanin degradation[32]. The results of periodically examined properties of the cheese fortified with traditional blanching and soaking hibiscus soft drink are shown in Table 4. In this study, the effects of cheese fortified with traditional blanching and soaking hibiscus soft drink on L*-value (lightness index), a*-value (redness index), b*-values (yellowness index), H*, C*, Browning Index (BI), ΔE, A_{420} nm (NE), polymeric colour, colour density, tannin contribution and total anthocyanin content were statistically significant found ($p<0.01$) in cheese fortified with traditional blanching and soaking hibiscus soft drink.

The L*-values were generally decreased in cheese fortified with traditional blanching and soaking hibiscus soft drink, that is the colour was to clear up. The decrease in L*-values point to increase of the colour was result of anthocyanin increasing. The a*-values obtained increased in cheese fortified with traditional blanching and soaking hibiscus soft drink samples. The increase of a*-value may stem from polimerization of anthocyanins and browning. The b*-values of cheese fortified with traditional blanching and soaking hibiscus soft drink samples more decreased in cheese fortified with traditional soaking hibiscus soft drink while decreased in the cheese fortified with traditional blanching hibiscus soft drink samples.

The red colour intensity also decreased cheese fortified with traditional blanching and soaking hibiscus soft drink accompanied by the tonality changes from red to yellow colour (b*-values), as the C* and H* values decreased (Table 4). In addition, since the L*, b*, a*, C*, H*, ΔE and BI values of cheese fortified with traditional blanching and soaking hibiscus soft drink indicate that anthocyanin increasing can be easily perceived by human eyes Gonnet[33]. Saturation index (Chroma) and Browning Index (BI) were increased in cheese fortified with traditional blanching and soaking hibiscus soft drink samples, while Hunter hue angle (H*) increased in the same samples. The ΔE increased in cheese fortified with traditional blanching hibiscus soft drink but decreased in cheese fortified with traditional soaking hibiscus soft drink samples (Table 4). As shown in Table 4, browning could not be noticed in cheese fortified with traditional blanching and soaking hibiscus soft drink samples. For example, the A_{420} nm of cheese control without soft drink was 57.57 and 47.75 compared to 10.02-44.29 in case of the cheese fortified with traditional blanching and soaking hibiscus soft drink samples. Crandall *et al.*[34] concluded that two measures of browning were used, colour a* or L* and absorbance at 420 nm where the higher numbers indicate increased absorbance due to the formation of brown pigments.

Data illustrated in Table 4 reveal that the Polymeric Colour (PC), colour density (TCD), tannin contributions (CDT) and total anthocyanines (TACN) were zero in white soft cheese (control) samples, while were high in all white soft cheese fortified with blanching and soaked hibiscus soft drink. Also, results indicated that the TCD and TACN in cheese samples increased by increasing blanching and soaked hibiscus soft drink ratio from 2-10% (Table 5). Approximately, no differences

in the PC of cheese fortified with blanching and soaked hibiscus soft drink. The total anthocyanines (TACN) were increased to 10.58 (mg/100 mL) in cheese fortify with 10% soaked hibiscus soft drink but were 9.57 (mg/100 mL) in cheese fortify with 10% blanched hibiscus soft drink (Table 5). Ascending total anthocyanines (TACN) results were corresponding to the results of ascending a*-values by increasing hibiscus soft drink ratio from 2-10% in white soft cheese samples, as seen in Table 4 and 5. However, anthocyanine pigments, being most heat sensitive may preferably be used as an index of food product quality.

Microbiological evaluation of white soft cheese fortified with traditional blanching and soaking hibiscus soft drink: White soft cheese is the most widely used cheeses in the cheeses industry. Also, hibiscus is a widely soft drink in a soft drink. Total Aerobic Bacteria (TAB) count number was 2.36 and the yeast and mould counts (Y and M) number was 1.46 CFU mL^{-1} in white soft cheese (Fig. 1), which was already lower than the legal standard (less than 105 CFU mL^{-1})[35].

During the processing are used to decontaminate the microorganisms but if they are poorly managed, the original contamination can remain very high even in freshly white soft cheese[36]. From the results, it was thought that sterilization process or adding an antimicrobial agent is necessary to ensure minimal adverse changes in quality. Figure 1 shows the total counts of aerobic bacteria, yeast and mould of white soft cheese samples. The microbiological tests were carried out immediately after the processing. The viable counts of the microorganisms in the white soft cheese samples were high (Fig. 1). Fortify blanching and soaking hibiscus soft drink effects on white soft cheese were observed in the populations of the total aerobic, yeast and mould (Fig. 1). Differences between blanching and soaking hibiscus cheese samples were observed, whereas, the populations of the total aerobic, yeast and mould in blanching hibiscus cheese samples was lower than in soaking hibiscus cheese samples.

The initial populations of the total aerobic bacteria in white sift cheese were reduced by increasing of blanching hibiscus concentration between 2 and 10% (0.98 and 1.46 CFU mL^{-1}). Approximately, 0.48 CFU mL^{-1} were reduced in the populations of the total aerobic by blanching hibiscus cheese, while the soaking hibiscus cheese and control showed the highest population (2.12 and 2.36 CFU mL^{-1}) in the samples. About 0.6 CFU mL^{-1} were reduced in the populations of the yeast and mould by blanching hibiscus cheese, while the soaking hibiscus cheese and control showed the highest population (1.33 and 1.46 CFU mL^{-1}) in the samples. Results indicated that the microbial counts of the Total Plate Count (TPC), yeast and mould decreased in blanching hibiscus cheese samples compared with soaking hibiscus cheese samples (Fig. 1).

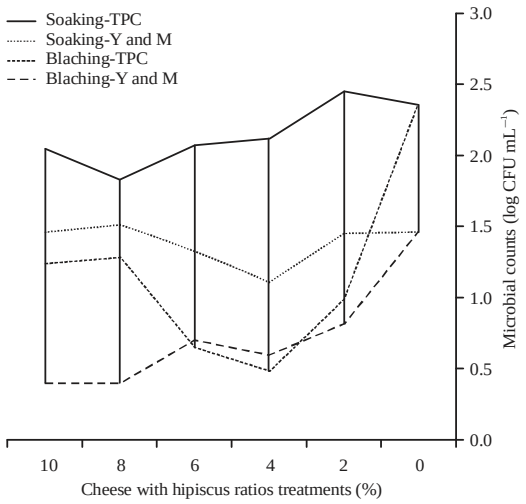

Fig. 1: Total plate count, yeast and mold counts (CFU mL^{-1}) of white soft cheese fortified with blanching and soaked hibicus soft drink

Table 5: Pigment parameters and anthocyanine content (TACN mg/100 mL) of white soft cheese fortified with hibiscus soft drink

Test/Treatments	TCD	PC	CDT (%)	TACN (mg/100 mL)
Cheese with soaked hibiscus soft drink				
C	0	0	0	0
1	0.044	0.04	98.20	2.13
2	0.072	0.06	78.83	4.17
3	0.115	0.06	52.88	7.51
4	0.138	0.06	46.38	8.72
5	0.158	0.07	41.96	10.58
Cheese with blanching hibiscus soft drink				
C	0	0	0	0
1	0.131	0.029	22.14	1.75
2	0.128	0.028	21.88	3.70
3	0.152	0.030	19.76	6.87
4	0.192	0.038	19.83	8.10
5	0.218	0.038	17.43	9.57

TCD: Colour density, PC: Polymeric colour and CDT: Tannin contributions

Sensory evaluation: Sensory analysis indicated that scores for the different attributes were affected by the ratio of hibiscus soft drink fortification Table 6. Cheese colour is one of the most parameter affected by the hibiscus soft drink fortification. Compared to the colour of control sample, the colour of cheese fortified with 2 and 4% by hibiscus soft drink had judging score acceptable but more percent hibiscus fortification gained rejected by the scoring persons. Cheese fortified with blanched hibiscus soft drink gained relatively flavour score compared with that fortified by soaked hibiscus

Table 6: Sensory evaluation of white soft cheese fortified with soaked and blanched hibiscus soft drin

Item/Treatments	Colour 15	Body and texture 35	Flavour 50	Total score 100
Soaked hibiscus soft drink				
Control	14.33	33.83	46.83	94.99
1	13.66	33.50	45.83	92.99
2	13.00	33.00	45.66	91.66
3	12.33	32.16	43.33	87.82
4	11.83	31.66	42.83	86.32
5	11.00	31.33	40.50	82.83
Blanched hibiscus soft drink				
Control	14.28	34.28	47.85	96.41
1	13.14	34.28	47.42	94.84
2	12.57	34.14	46.43	93.14
3	11.42	33.14	44.14	88.70
4	10.14	31.85	41.71	83.70
5	9.43	30.14	40.43	80.00

soft drink. Overall, cheese fortification up to 6% of hibiscus soft drink had gained acceptable organoleptic properties. Increasing the percentage hibiscus soft drink fortification more than 4% led to rejected by the scoring persons especially of cheese colour.

CONCLUSION

Cheese colour and flavour can be more acceptable and satisfied by the scoring experts with fortification by hibiscus soft drink up to 6%. Microbial quality was improved with hibiscus fortification. White soft cheese can be produced with fortification by hibiscus soft drink as antimicrobial (food preservation technique) and hypertension treatment that can be explored commercially to benefit for both the producers and consumers.

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