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Research Article

Texture, Chemical Properties and Sensory Evaluation of a Spreadable Processed Cheese Analogue Made with Apricot Pulp (*Prunus armeniaca* L.)

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Abstract

Apricot is a natural source of polyphenols and other phytochemicals such as β-carotene and ascorbic acid that contribute to its antioxidant activity. Apricot pulp can be applied as a material for enriching different kinds of food systems such as ice cream, processed cheese. Analogue processed cheeses (PCSs) were made with different ratios of apricot pulps (10, 20 and 30%) which sweetened with different proportions of sugar (5, 10 and 15%). The base blends were standardized to contain 60% material moisture and 36% fat in dry matter in the resultant control spreads. The PCSs were evaluated for chemical, texture and sensory properties during storage at 25°C and 5°C for 3 months. The results revealed that addition of apricot pulp and sugar resulted in in PCSs with higher total solids, fiber, carbohydrates, vitamin A and potassium contents, as compared with the control cheese spread product. However, the control treatment had the highest contents of protein, ash, soluble nitrogen, fat in dry matter, as well as pH values as compared with the other treatments. Moreover, the textural characteristics of PCSc were revealed that the hardness, gumminess, cohesiveness and springiness in all treatments were lowest than the control cheese. On the other hand, the sensory evaluation scores revealed that all PCSs treatments were accepted for panels and there were slightly differences between all treatments. Furthermore, PCSs made the highest percent of apricot (30%) with the highest sugar content (15%), fresh as well as, stored was the significantly most accepted, while the control sample was the least.

Key words: Spreadable processed cheese analogue, apricot, chemical properties, texture analysis, sensory evaluation

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INTRODUCTION

Increasing interest in nutrition, fitness and beauty consciousness has enhanced concerns over a healthy diet. Fruits and vegetables have assumed the status of functional foods, able to provide additional health benefits, like prevention or delaying onset of chronic diseases, as well as meeting basic nutritional requirements. Nowadays, food scientists have collaborated with nutrition researchers to develop plant-based functional foods to promote healthy eating habits.

Apricot (*Prunus armeniaca* L.) is one of the most fruit cultivation with a total world production of around 3.4×10^6 t (FAO., 2012). More than 80% of the world production comes from Mediterranean countries. Apricots fruits are appreciated by consumers for their characteristic flavor, sweetness and juiciness, which are strongly related to the variety and ripening stage. Nutritionally, apricot is a good source of vitamins A and C, dietary fibers and minerals, sugars (mainly glucose, fructose and sucrose) and organic acids (mainly malic, citric and quinic acids) with excellent sensory and nutritional properties (Iahtisham *et al*., 2015). Apricots also contain certain phytochemicals that have beneficial effects on human metabolism. Among these phytochemicals, phenolic compounds such as chlorogenic acid, rutin, catechin and epicatechin are predominant. In general, the content of phenolic compounds in apricots is positively correlated with their antioxidant capacity (Dragovic-Uzelac *et al*., 2005). More than 80 aroma compounds have been identified in the volatile fraction of apricots, with terpenes, esters, lactones, aldehydes and alcohols being the main chemical families. Volatile compounds directly affect the sensory quality of fresh and processed fruit products, especially their odor, aroma and flavor.

High sodium consumption is associated with increased urinary calcium excretion, a higher risk of osteoporosis (Heaney, 2006) and occurrence of kidney stones (Massey, 2005). Excess sodium intake has been linked also to an increasing risk of high blood pressure, cardiovascular disease and stroke (Appel *et al*., 2011). Seventy seven percent of sodium comes from packaged food, of which cheese is the second largest source. The regular Cheddar cheese contains ~6200 mg kg^{-1} of salt, which in a 50 g serving size contributes almost 13.5% of daily recommendation (FDA-DHHS., 2010; USDA., 2010).

Potassium is considered as one of the concern nutrients for adults. Randomized trials have shown that increasing potassium intake in the diets is linked with lower cardiovascular mortality (He *et al*., 2010), lower blood pressure (He *et al*., 2005) and is likely to prevent or at least slow down the progression of renal disease (He and MacGregor, 2008). In addition, potassium may promote renal calcium retention, resulting in more positive calcium equilibrium (Zhu *et al*., 2009). So overall, potassium contributes to greater bone mineral density, especially for elder people (Whiting *et al*., 2002).

The mineral compositions of kernels were found to vary widely depending on different apricot cultivar kernels. Ca, K, Mg, Na and P contents of all the apricot cultivar kernels were generally found very high. In addition, other minerals were determined very low. The K contents were determined between 6206.5 and 12715.9 mg kg^{-1} (Ozcan *et al*., 2010).

Processed cheese and processed cheese analogues are most of the dairy products that having high consumption pattern by large sectors of population, specially the children. Their popularity as products may be attributed to several factors including, inter alia, the diversity they offer in flavor, texture and cooking properties; easy customization to cheese ingredient applications, adaptability to fast food trade and their attractive packaging into convenient formats as well as shapes. Such diversity is controlled by changes in formulation, processing conditions and composition (Chambre and Duurelles, 2000). Cheese has health promoting characteristics associated with certain immune functions in the body. However, it lacks vitamin C, polyphenols and short of carotenoids which play important role as antioxidants in the human body (Sharma *et al*., 2011). Fruits and vegetables are a good source of natural antioxidants, containing many different antioxidant components which provide protection against harmful free radicals and have been associated with lower incidence, mortality rates of cancer and heart diseases in addition to a number of other health benefits.

So, the aims of this study were fortifying this favorable product of the high consumption pattern with apricot may insure ingestion of the desired amount of processed cheese analogue with low sodium/potassium ratio and high contents of vitamins and antioxidant compounds especially for children who prefer sweet product with a distinctive color than the normal processed cheese and its analogues. The alterations in the chemical composition, texture and sensory acceptance caused by apricot addition also were assessed.

MATERIALS AND METHODS

Materials: Commercial JOHA emulsifying salts were obtained from BK-Ladenburg corp., Gmbh, Germany. Unsalted butter was obtained from Dina farm, Sadat city. Low heat skim milk powder was procured from Irish Dairy Board, Grattan House, Lower Mount St., Dublin, Ireland. Fresh raw buffalo's milk was obtained from the National Research Center, Giza. Calf rennet powder (Ha-La) and whey protein powder were obtained from CHR- Hansen's Lab. Denmark. The following ingredients were purchased from local market in Cairo, Egypt.

Sugar and Apricot (*Prunus armeniaca* L., obtained during the season). Chemical composition of the ingredients used in the manufacturing of apricot processed cheese analogue (APCS) presented in Table 1.

Methods

The preparation of apricot pulp: The washed apricots were dried and then processed immediately for extraction of pulp. For pulp extraction electric blender of good quality was used. The pulp was separated from the stones of fruit. The extracted pulp was placed in water bath at a temperature of 82°C for 30 min as described by Hussain *et al.* (2014).

Manufacture of unsalted soft cheese base: The soft cheese manufacture was carried out according to method reported by Shahein *et al.* (2014). Milk was pasteurized at 72°C for 15 sec in a water bath and cooled immediately to 39±1°C, 0.04% calcium chloride and calf rennet at the rate of 4 g/100 L of milk (after diluted 10 times with water) were added to coagulate in about 3 h. The resulted curd was then transferred to perforated cheese molds over night to remove all the whey then stored at 4°C until used.

Manufacture of apricot processed cheese analogue spreads (APCSs): Processed Cheese Spreads (PCSs) were manufactured, according to the method of Meyer (1973). The composition of control batch of processed cheese treatments was adjusted to contain 60±1% moisture and 34±1% fat in dry matter. Control processed cheese was made unsalted soft cheese and butter as a base blend. Processed cheese treatments manufactured by adding apricot pulp in the base blend at ratios of 10, 20 and 30% and sugar (5, 10 and 15%) for each apricot treatment. All blends were cooked with controlled agitation for 8 min at 85-90°C using direct injection steam at pressure of 1.5 bar. The hot product of APCSs were manually filled into 150 cc sterilized glass jar and also covered with aluminum foil, then rapidly cooled at 7±1°C. The resultant APCSs were analyzed when fresh and after 1, 2 and 3 months of storage at 7±1 and 25±1°C. The compositions of different blends of APCSs are shown in Table 2. Three replicates of each treatment were manufactured and subjected for analysis.

Chemical analysis: Samples of cheese analogues were tested for moisture, ash and fiber contents as mentioned in AOAC (2006). Fat, total, soluble and non-protein nitrogen contents were determined according to the method described in Ling (1963). Values of pH were measured using a digital pH meter (HANNA), with combined glass electrode (Electric Instruments Limited). Total carbohydrates were calculated by differences as described by James (1995).

Salt content was determined as described by Bradley *et al.* (1993). Mineral profile of fresh PCSs was assayed for determined K, Na contents using a flame photometer (Corning 410, Corning Medical and Scientific Instrument, Modified, MA, USA) as mentioned by Mohamed *et al.* (2011).

Total Phenolic Contents (TPC): Total phenolic compounds were determined according to Zheng and Wang (2001) by using Folin-Ciocalteu reagent and expressed as milligrams of Gallic Acid Equivalents (GAE) per 100 g.

Table 1: Chemical composition of the ingredients used in manufacture of processed cheese analogue spreads

Ingredient	TS (%)	F (%)
Unsalted cheese	30	10.5
Whey protein powder	95	0.7
Unsalted butter	84	82
Skim milk powder	96	0.1
Apricot pulp	18	-

TS: Total solids, F: Fat

Table 2: Formulations of the different blends used for manufacture of processed cheese analogue spreads

Ingredient	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9
Unsalted cheese base	35.61	28.25	24.72	21.98	27.15	23.61	20.90	26.14	22.61	19.92
Whey protein powder	11.87	9.42	8.24	7.32	9.05	7.87	6.97	8.72	7.54	6.64
Skim milk powder	4.75	3.77	3.30	2.93	3.62	3.15	2.78	3.49	3.02	2.66
Unsalted butter	13.53	13.18	11.54	10.26	12.67	11.02	9.75	12.20	10.55	9.30
Apricot pulp	-	5.46	4.78	4.25	10.50	9.13	8.08	15.16	13.12	11.56
Sugar	-	6.00	10.51	14.02	6.30	10.96	14.55	6.57	11.37	15.02
Emulsifying salt	1.66	1.09	0.95	0.85	1.05	0.91	0.81	1.01	0.87	0.77
Water	32.58	32.83	35.96	38.39	29.66	33.35	36.16	26.71	30.92	34.13
Total	100	100	100	100	100	100	100	100	100	100

Table 3: Chemical composition of processed cheese analogue spreads made with different ratios of apricot pulp

Compositions	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9
TS (%)	39.33[a]	40.88[a]	40.79[a]	40.82[a]	40.90[a]	40.87[a]	40.81[a]	40.78[a]	40.86[a]	40.84[a]
F/DM	36.15[a]	34.60[a]	30.28[bc]	26.90[bc]	33.26[ab]	28.92[c]	25.60[c]	32.00[b]	27.70[bc]	24.40[cd]
Protein	14.50[a]	12.87[ab]	12.52[ab]	12.11[b]	12.45[b]	12.22[b]	12.01[b]	11.95[b]	11.51[b]	11.13[b]
Ash (%)	4.08[a]	3.54[a]	3.32[ab]	3.12[b]	3.60[ab]	3.42[ab]	3.23[ab]	3.39[ab]	3.71[ab]	3.44[ab]
Salt in moisture (%)	1.69[a]	1.36[ab]	1.22[b]	1.12[b]	1.32[ab]	1.18[b]	1.08[b]	1.28[ab]	1.14[b]	1.04[b]
Na (mg kg^{-1})	1686[a]	490[b]	481[b]	470[b]	441[b]	430[b]	421[b]	365[c]	360[c]	352[c]
K (mg kg^{-1})	112[c]	910[b]	892[b]	880[b]	921[b]	915[b]	911[b]	1130[a]	1100[a]	1086[a]
Na/K ratio	15.05	0.538[a]	0.539[a]	0.534[a]	0.479[a]	0.470[a]	0.462[a]	0.323[a]	0.327[a]	0.324[a]
Fiber (%)	-	0.213[b]	0.190[b]	0.175[b]	0.425[ab]	0.401[ab]	0.386[b]	0.692[a]	0.631[a]	0.598[a]
Carbohydrates (%)	2.0[c]	7.5[b]	12.1[a]	15.5[a]	7.6[ab]	12.0[a]	15.9[a]	7.7[b]	12.8[a]	16.4[a]
Vitamin A (µg 100 g^{-1} fat)	1.2[c]	4.2[bc]	3.8[bc]	3.6[bc]	5.2[ab]	5.9[a]	5.8[a]	8.8[a]	8.5[a]	8.2[a]
pH	5.69[a]	5.50[a]	5.56[a]	5.61[a]	5.49[a]	5.53[a]	5.58[a]	5.40[a]	5.49[a]	5.53[a]

TS: Total solids, F/DM: Fat in dry matter, Na: Sodium, K: Potassium, Mean values in the same row bearing the same superscript do not differ significantly (p>0.05)

Antioxidant capacity: Free Radical Scavenging Activity (RSA%) assay of the samples was measured using the method of Brand-Williams *et al.* (1995) and expressed as percentage inhibition of the DPPH radical and was determined by the following equation:

$$RSA\% = (Abs_{control}-Abs_{sample})\times 100/Abs_{control}$$

Determination of vitamin A: The concentrations of vitamin A (all trans retinol) in the cheeses were measured simultaneously by means of normal phase HPLC using a UV-VIS photodiode-array detector after saponification and hexane extraction, adapted from Lucas *et al.* (2006). The results were expressed as µg vitamin/100 g fat.

Textural measurements: Force and torque measurements of processed cheese treatments were measured using a texturometer model Mecmesin Emperor TMLite 1.17(USA). Mechanical primary characteristics of hardness, springiness, gumminess and cohesiveness were determined from the deformation Emperor TMLite Graph. Also the secondary characteristic of chewiness (hardness×cohesiveness× springiness) was selected because the cheese samples showed springiness (Lobato-Calleros *et al.*, 1997).

Sensory evaluation: The processed cheese samples were subjected to sensory analysis by 10 of the staff members at the Food Science Department, National Research Centre, according to the scheme of Meyer (1973). The organoleptic scheme used consisted of flavor (40 points), body and texture (40 points), appearance and color (20 points).

Statistical analysis: The obtained data were expressed as mean values. Statistical analysis was performed using one way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test with $p\leq 0.05$ being considered statistically significant using SAS program (SAS., 2001).

RESULTS AND DISCUSSION

Chemical composition of apricot processed cheese analogue: The changes in gross chemical composition of APCSs made with adding apricot pulp (at ratios 10, 20 and 30%) and sugar (at ratios 5, 10 and 20%) in the blend of the cheese spread base are shown in Table 3. Apricot PCSs had insignificant higher contents of total solids, fiber and carbohydrates than the control spread. On the other hand, control treatment made without any adding possessed the highest significantly ($p\leq 0.05$) contents of fat in dry matter (F/DM) and protein. Increasing the percentage of apricot pulp and sugar in the formula decreased the contents of total protein, salt in moisture and ash in the resulting PCSs, are mainly due to the lower contents of these components in apricot pulp used in PCSs. The sugar increased significantly ($p\leq 0.05$) the carbohydrates content in apricot cheese, the fiber also was higher in all treatments as well as the both of them were increased significantly ($p\leq 0.05$) by increasing the apricot pulp ratios. The previous results in agreement with those obtained by Awad *et al.* (2003) who prepared processed cheeses with guava, mango and banana pulps.

The adding of apricot and sugar in the base blend resulted in insignificant slightly decreases pH values of the PCSs than the control cheese (Table 3). In another means, control spread had slightly higher pH values as compared with the other treatments. Also, among the treatments when the percent of pulp were increased, the pH values were decreased. This could be due to the lower pH value of fruit pulp used in the formula (~pH = 5.4) as compared with pH of control. During the storage period at 5 and 25°C for 3 months (data not shown), the pH values were decreased during the storage period and at room temperature these reduction were increased, it could be due to the high temperature encouraged the hydrolysis of protein. The slight reduction in pH values during the storage period could be attributed to a limitation growth and activity of resistant microflora, such as heat resistant proteinases or psychrotrophic bacteria present and enzymes in the product, which cause a hydrolysis of lactose to some acids. It could be also due to the hydrolysis of polymerized phosphate present in the emulsifying salts and their interaction with protein. These results agree with researches conducted by Tamime *et al*. (1990) and Aly *et al*. (1995).

Mineral profile of APCSs: As mentioned by Johnson *et al*. (2009), the three major ingredients that contribute to sodium in processed cheese are emulsifying salts sodium-based (approximately 44-48%), natural cheese (approximately 28-37%) and added salt (approximately 15-24%). Therefore, sodium reduction initiatives in processed cheese involve mainly the modification of 1 or all 3 ingredients during processed cheese formulation and manufacture. Numerous research efforts in the past have been targeted toward the development of reduced and/or low sodium natural cheese as an ingredient for processed cheese (Metzger and Kapoor, 2007). Efforts have also been directed at the development of novel formulations in order to utilize potassium-based emulsifying salts, various salt replacers and other flavor enhancers (Henson, 1997; Metzger and Kapoor, 2007). So, the addition of apricot pulp could be help in the reduction of sodium and increase the potassium content.

Data presented in Table 3 showed that the addition of apricot pulp increased K content of APCSs consequently and the ratio of Na/K was also decreased insignificantly between the apricot treatments. Control sample has 112 mg K/100 g PCSs while increased to 1086 mg K/100 g in cheese fortified with 30% apricot pulp. It is clear that gradual significant increase was observed with increasing apricot pulp ratios to 30%. From the results of Na and K it could be say that this product could be very healthy product for children and any person with the high sodium content causes problem as hypertension.

Vitamin A contents in APCSs: Vitamin A is necessary for many essential processes of life such as: metabolism, cell homeostasis, bone development in the growth process and embryo development, proper functioning of epithelial cells, it modulates the immune function and increases the resistance body to infectious diseases. These processes can be supported by all forms of vitamin A: retinol and retinal esters, including β-carotene. Vitamin A cannot be synthesized by the human body. Daily requirement must be provided by diet under the preformed of retinol (retinyl esters) from the food of animal origin and through provitamin A (carotenoids) from the vegetables products. Deficiency of vitamin A affects the vision, causing corneal degeneration and dryness. Table 3 was shown the content of vitamin A in all samples. The content of vitamin A was higher in all treatments than the control sample and this makes sense to the presence of this vitamin in apricot pulps. These finding in agreement with the increasing of pulp ratio, the content of vitamin was increased significantly ($p \leq 0.05$). Through the results obtained for the vitamin can transpire this new product for children to help provide part of the daily requirement of this vitamin, and thus improve their health and body.

Total Phenolic Content (TPC): Phytochemicals are presumed to limit the expression of oxidative stress in the body because of their biochemical ability to reduce the free radicals (Chu *et al*., 2002). The other benefits of including fruit and vegetables in the diet include glucosinolates (Heber, 2004) or dietary fiber (Fahey, 2003). Cheese has health promoting characteristics associated with certain immune functions in the body. However, it lacks vitamin C, polyphenols and short of carotenoids which play important role as antioxidants in the human body. Cheese contains a small amount of phenols (O'Connell and Fox, 2001) also lacks vitamin C and many important antioxidants (Buttris, 2003). Therefore, the main aim of this study was to develop a novel product by blending apricot pulp into the processed cheese analogue mixture for better nutrition and health promoting principles like antioxidants and other beneficial phytochemicals.

Table 4 demonstrated that, there was highly increase in TPC in cheese samples supplemented with apricot pulp and was proportional to the concentration of pulp added. This ascribed to the TPC of apricot fruit as mentioned before which remained in cheese curd. The rate of increase in TPC in fresh cheese samples supplemented with 30% apricot pulp and 10-15% sugar were the highest than other treatments. The obtained results were in according with that mentioned by Sochor *et al*. (2010) who determined the total phenolic

Table 4: Antioxidant properties of processed cheese analogue spreads made with different ratios of apricot pulp

Treatments	RSA (%)	TPC (mg/100 g equivalent gallic acid)
Control	2.4	15
T1	53.8^{ab}	541.4^{a}
T2	52.5^{b}	544.7^{a}
T3	51.7^{b}	547.6^{a}
T4	56.1^{ab}	561.1^{a}
T5	55.88^{ab}	563.9^{a}
T6	54.61^{ab}	564.2^{a}
T7	59.8^{a}	566.8^{a}
T8	58.1^{a}	568.2^{a}
T9	57.8^{a}	578.8^{a}

RSA: Free radical scavenging activity, TPC: Total phenolic compounds, Mean values in the same column bearing the same superscript do not differ significantly ($p>0.05$)

compound in 21 genotypes of apricot and found that the content average from 48-170 TPC (mg/100 g equivalent Gallic acid).

During cold storage (data not shown) the TPC gradually decreased for all treated samples (three months), this may attributed to the transformation of PC which highly unstable compounds and undergo numerous enzymatic and chemical reactions during food storage as stated by Poncet-Legrand *et al.* (2006).

Radical Scavenging Activity (RSA %): As mentioned by Sochor *et al.* (2010) the most of phenolic compounds occurring in fruits display antioxidant activity, which is defined as the ability of a compound or a mixture thereof to inhibit oxidative degradation of various substances via scavenging of reactive species, including free radicals.

Data presented in Table 4 revealed that, supplementing cheese analogue with apricot pulp increased the RSA in the resultant APCSs cheese by increasing the percentage of added fruit pulp and sugar. It was noticed that, RSA% of fresh cheese supplemented with 10 and 30% fruit pulp increased by 53.8 and 57.8% respectively, however, the percentage of RSA gradually decreased during cold storage (three months) for all cheese treatments. The obtained results were in the same line with Corbett *et al.* (2015) who reported that organic and aqueous extracts of Apricot Pit Shells (APS) were shown to have strong antioxidizing properties indicating that APS could potentially be a feedstock for the production of antioxidant supplements, preservatives and stabilizers. Based on the above mentioned results it can be concluded that antioxidant activity is closely correlated with the total content of polyphenols.

Textural properties of APCSs: The compositional differences between the experimental APCSs were in line with the expected differences from the used formulations and the resultant analogues that were clearly unlike in some textural attributes, especially firmness. Treatments with high ratios of apricot content were in general softer, while those with lower content were firmer and easier to handle (Table 5). The shortage in firmness caused by the increase in the moisture content of the treatments was expected. It occurs due to the greater hydration and consequent weakening of the casein network (Pereira *et al.*, 2001).

The addition of apricot pulp resulted in a significant ($p \leq 0.05$) decrease in the APCSs firmness in comparison with the control sample. Furthermore, raising pulp and sugar (10-30%) results in general tendency for a decrease in firmness. This can be related to the fact that apricot pulp has low protein content. On the other hand, Kaminarides *et al.* (2006) reported that increasing the Halloumi cheese, salt and ash contents of the blend increased the hardness of the resulting processed cheese.

By the same way, the other textural parameters included cohesiveness, gumminess, chewiness, springiness and resilience, were decreased significantly by increasing the ratio of apricot pulp. Korish and Abd-Elhamid (2012) mentioned that the lowest values of hardness, springiness and chewiness in Kareish cheese, may be due to the increase in cheese moisture content.

Organoleptic evaluation of APCSs: Sensory analysis of APCSs is an important contribution to their possible future commercialization, since it gives a perspective of the potential consumer's acceptance.

Organoleptic properties scores of resultant APCSs when fresh are summarized in Fig. 1.

It was unexpected that the increasing the sugar takes higher degrees, so the treatment with 30% apricot pulp and 20% sugar was the best one. General acceptability of cheese treatments is concerned with texture, odor and flavor attributes. The flavor was found to be the most important attribute that affect the acceptability of a cheese analogue containing apricot pulp in different ratios. However, all analogues treatments scored positively revealing a good acceptance by the panelists. There were significant

Table 5: Texture profile analysis of processed cheese analogue spreads made with different ratios of apricot pulp

Properties	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9
Firmness	7.278^{a}	6.370^{ab}	6.190^{ab}	6.800^{a}	5.980^{ab}	5.921^{ab}	5.895^{ab}	4.660^{b}	4.625^{b}	4.601^{b}
Cohesiveness	0.961^{a}	0.905^{a}	0.901^{a}	0.895^{a}	0.876^{a}	0.870^{a}	0.866^{a}	0.829^{a}	0.826^{a}	0.822^{a}
Gumminess	5.922^{a}	5.762^{a}	5.896^{a}	5.924^{a}	4.269^{ab}	4.396^{ab}	4.486^{ab}	3.864^{b}	3.921^{b}	3.996^{ab}
Chewiness	5.805^{a}	5.684^{a}	5.755^{a}	5.821^{a}	3.920^{ab}	3.995^{ab}	4.068^{ab}	2.754^{b}	2.805^{b}	2.992^{ab}
Springiness	0.994^{a}	0.986^{a}	0.990^{a}	0.998^{a}	0.851^{ab}	0.855^{ab}	0.867^{ab}	0.713^{b}	0.719^{b}	0.735^{b}
Resilience	0.659^{a}	0.624^{ab}	0.629^{ab}	0.635^{ab}	0.456^{bc}	0.461^{bc}	0.468^{bc}	0.297^{c}	0.311^{c}	0.325^{c}

Mean values in the same row bearing the same superscript do not differ significantly ($p > 0.05$)

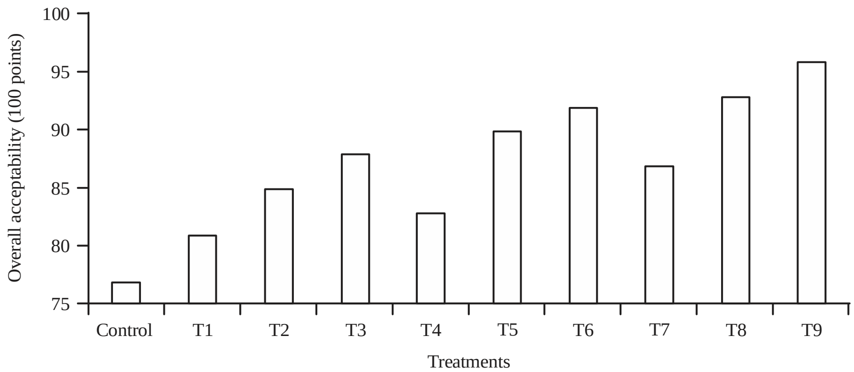

Fig. 1: Overall acceptability of apricot processed cheese analogues

differences detected by the panelists between analogous with fruit pulp and the control.

CONCLUSION

From the all results and sensory evaluation results, it could be concluded that the addition approximately 30% apricot pulp and 20% sugar in the APCSs have significant effect on the overall acceptability score of it and in the same time introduced a new healthy alternative processed cheese analogue with favorable properties especially for children. In the same time, the apricot cheese is a novel type of product for health awareness, such as antioxidant properties, low sodium potassium ratio and high content of vitamins and minerals than the normal processed cheese.

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