Effect of using *Jojoba* and *Moringa* protein concentrate as a fat mimetic on physical and sensory properties of cupcake.

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Abstract

This research study was primarily conducted for the purpose to examine the *Jojoba* and *Moringa* protein concentrate as a fat mimetic on physical and sensory properties of cupcake. Fat replacers can be used to help decrease the amount of fats used in cooking; therefore, these health risks can be reduced. This study showed that Sensory quality was assessed by ten experienced panelists from Desert Research center, using attributes such as bread taste, flavor, firmness, softness, crumb and crust colors, appearance and overall acceptability. Principal components and cluster analyses confirmed two groupings of treatments with *Jojoba* and *Moringa* protein concentrate as a fat mimetic. It is concluded that treatments with 25% and 50% fat replacement were tastier and more acceptable. Finally, *Jojoba* and *M. olifeira* protein concentrate presented good functionality for utilization in food formulations.

Keywords: *Jojoba, Moringa*, Protein concentrate, Fat mimetic and cupcake.

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Introduction

Now-a-days people are very particular about their relation between diet and health and more over they prefer food of low calorie which is healthy to the body. Usually for any occasion cakes are preferred first and which always been the children favourite food. Apart from the diet foods, cakes, burgers, pizzas, etc. are playing major role in the eatables. In return they are causing diseases such as constipation, tumours and heart attacks. In order to prevent the major health problems right food at right time must be taken. Proteins which paly major role in the diet. Essential proteins are not synthesized from our body they are consumed through taking vegetables, fruits, etc. whereas nonessential proteins are synthesized in body itself. Deficiency of proteins causes the serious problems such as malnutrition (marasmus and kwashiorkor) plant proteins are preferred first because they worth low and effective compared to animal protein [1].

On other hand fat contributes to flavor, or the combined perception of mouthfeel, taste, and aroma/odor. Fat additionally contributes to thickness, appearance, taste property, texture, and lubricity of foods and will increase the sensation of fullness throughout meals. Fat replacers are categorized into two types which are Fat substitutes and fat mimetis Fat substitutes are similar to fats which replaces triglycerides in food. Particular examples of fat substitutes are sucrose polyesters, which cannot be digested in small intestine and are passed directly into large intestine. Fats Mimetics can be carbohydrates or proteins and can replace fats in foods because of their textural organoleptic properties. Beside fats dietary fiber is believed to have positive effects on Human Nutrition and Human Health. And anyway, high intake of food which is rich in of dietary fiber is associated with lower risk of many diseases such as chronic bowel diseases, coronary heart diseases, and a various types of cancer [2].

Jojoba (*Simmondsia chinensis* (Link) Schneider) is an oil yielding desert shrub (family Simmondsiaceae) of arid and semi-arid areas [3]. Commercially *Jojoba* is grown for its oil which having lubricating properties. Besides being known for its lubrication, *Jojoba* has attracted interest towards, cosmetics, pharmaceuticals, animal feeding, and landscape as soil conservation [4]. *Jojoba* seeds have also been used in cleaning of aquatic system mainly for the removal of access ferric ions [5]. After oil extraction its defatted meal, represent a potential supplement for animal feeds. Once defatted, the major constituents of it are proteins (31%) and carbohydrates (55%) [6].

Jojoba industry faces the challenge of finding ways to improve productivity and quality of the products. There are number of different *Jojoba* accessions which are grown in *Jojoba* farms. This is mandatory to comparably evaluate them for its commercially important chemical properties [4].

Moringa oleifera (*Moringa*ceae), which is fast growing tree and has fragile branches, tripinnaye leaves. They grow in semiarid and tropical regions. They are used in herbal medicine and pharmaceutical cosmetics too. They are given to infants and nursing mothers to fight malnutrition. The relative lack of anti-nutritional elements and also the high macromolecule, super-molecule Associate in nursing sulphur containing organic compound contents encourage the employment of *Moringa* seed as an animal feed. It's a wonderful supply of proteins for monogastric animals. The inhibitor action of some compounds gift within the plant, one amongst the foremost necessary physiological roles of food, will defend organisms against the hurtful effects of oxidization.

Objectives of the study

Thus, the aim of this study were to research the practicableness of victimization the *Jojoba* and *Moringa* super molecule

concentrate as a fat mimetic and to check its result on physical and sensory properties of cake. For this purpose, seven different formulations were examined which was the control cake (without protein concentrate) and cake with fat replacement of 25, 50 and 75% w/w.

Materials and Methods

The following procedure was adopted by the researcher for the purpose to reach at certain findings and conclusion.

Preparation of protein concentrate

The concentrates from pressed meal were prepared according to methods described [7]. A pressed cake (meal) was obtained from a press operation and extracted with hexane until the solvent was no longer colored. The defatted meal was spread out in trays to dry overnight at 20°C. the defatted meal was subsequently ground with a hammer mill through 60 mesh screens. Protein concentrate were obtained by extracting the defatted meal with hexane solvent (1:20, w/v) at 20°C. SDI (spray-dried concentrate I) was obtained after washing the meal with methanol / acetone (3:1) and by rewashing SDI protein concentrate with a solution of methanol and IN HC1 (98:2) (SDII).

Processing of cupcakes formulas

All formulas of substituted wheat flour at different substitution levels by both protein concentrates were summarized in Table 1. The processing method of cupcake was taken typically according to AACC [8] in steps sequence as: The shortening was melted thoroughly; sugar and salt were added then mixed vigorously. The whole egg was mixed with vanilla and whipped until got puff and smooth like-cream texture. Additionally, substituted wheat flour (72% extraction) with baking powder and skimmed milk powder then added gradually to whipped egg mixture. This mixture was mixed gently until got homogenous dough using Hand mixer (MK-H4-W, Panasonic Co). After getting appropriate texture the dough was poured into paper cups and backed at 180°C ± 5°C for 30 to 35 min. The baked cupcakes were cooled down at room temperature, and then packed into aluminum foil bags intervals for analysis. Six fat mixes were prepared from *Jojoba* protein with shortening and *Moringa* protein with shortening as shown in Table 2.

Table 1. *Raw ingredients of processed cupcake.*

Ingredients	Weight (g)
Soft wheat flour (72% extraction)	250
Sugar	125
Salt	3.5
Skimmed milk powder	25
Shortening	53.5
Fresh whole egg	110
Baking powder	12.5
Vanilla	2

Proximate analysis

Water, protein, fat, crude fiber, ash, contents of the raw materials and the cupcakes were determined according to the methods of AOAC [9]. Total carbohydrates (TC) were calculated by difference.

2-4 Amino acids: Amino acids were determined using a BECKMAN 6300 amino acid analyzer according to the method of Spackman [10]. Hydrolysis of samples was performed in the presence of 6 M HCl, trifluoroacetic acid (TFA, 2:1, v/v) and 5% thioglycolic acid, for 24 h at 100°C prior to amino acid analysis.

2-5 Physical characteristics: The normal weight of baked cupcakes was individually determined within 1 h after baking. Also, volume in different substituted cupcakes was determined by method according to AACC [11] and specific volume was calculated for these formulas [Volume (cm^3)/Weight (g)].

2-6 Sensory evaluation: Cupcakes were evaluated for its sensory characteristics, i.e., taste, odor, appearance, crust color, crumb color and crumb texture. The evaluation was carried out by ten experienced panelists from Desert Research center, according to the method of Larmond [12]. A 9-point scale was used for the sensory evaluation: (1) very bad, (2) bad, (3) poor, (4) relatively poor, (5) intermediate, (6) good, (7) very good, (8) excellent, and (9) very excellent.

Results and Discussion

Proximate composition and yield of protein concentration

The proximate composition of *Jojoba* and *Moringa* defatted seed meal is presented in Figure 1. Protein was the major macromolecule in *Jojoba* defatted seed meal (35.8%) after carbohydrates (43.2%). Higher protein content values were reported for *Moringa* defatted seed meal (58.4%). *Jojoba* meal reported higher content of fiber, moisture and ash (13.1%, 3.9% and 3.7% respectively) than *Moringa* meal (4.9%, 2.7% and 2.3% respectively). Protein content was significantly ($p<0.05$) higher in *M. oleifera* meal compared to *Jojoba* meal. Defatted seed meal was found to have fat content about (0.3 and 0.1%) for *Jojoba* and *Moringa* respectively.

The concentrate pressed meals were reduce weight from 50% to 55% while removing simmondsin content in *Jojoba* and pressed meals and reduced content of polyphenol in all concentrate of *Jojoba* and *Moringa*. The functional properties were investigated most thoroughly with the SDII concentrate because this concentrate had the lowest concentration of simmondsin, a toxic compound in *Jojoba*, and polyphenolic compounds [7]. The concentration of simmondsin must be reduced before *Jojoba* meal or protein concentrates can be used in food or feed products. Table 3 shows the protein yield of pressed meal

Table 2. *Formula of the cupcakes.*

7				*Moringa*			
Sample	**Shortening**	***Jojoba* protein**	**Fat (%)**	**Sample**	**Shortening**	***Moringa* protein**	**Fat (%)**
Control	53.5	-	100	Control	53.5	-	100
JP 25	40	13.5	75	MP 25	40	13.5	75
JP 50	26.75	26.75	50	MP 50	26.75	26.75	50
JP 75	13.5	40	25	MP 75	13.5	40	25

concentrate of *Jojoba* and *Moringa* SDI. Water extractable protein obtained after washing the meal with methanol/acetone solution, SDII. SDI protein concentrates after washing with a methanol/HCl solution

Amino acid composition

The amino acid composition of *Jojoba* and *Moringa* defatted seed meal is presented in Table 4. Regarding essential amino acids content, both *Jojoba* and *Moringa* meal were found to be rich in leucine (6.24 and 7.43%, respectively) and valine (4.32 and 7.24%, respectively). *Jojoba* defatted seed meal showed higher isoleucine, lysine, Tyrosine and Serine contents than *Moringa* defatted seed meal. It was also *Moringa* meal was poor in Tryptophan. The major nonessential amino acids were observed to be glutamic acid (16.48% and 22.37%) and glycine (8.32% and 12.61%), respectively for *Jojoba* and *Moringa* defatted seed meal leaf. The quality of proteins as source of amino acids can usually be adequately assessed by comparison with the FAO/OMS [13-18] recommended qualified an ideal protein as one in which 36% the total residues of essential amino acids. Compared to the defatted seed meal of *Jojoba* and *Moringa* reported higher total essential amino acids content, and both meal had higher total essential amino acids than the FAO/OMS [18-24] reference pattern. These results showed that *Jojoba* and *Moringa* defatted seed meal could be used as a source of proteins, which contain high amount of proteins.

Table 3. *Protein yield of Jojoba and Moringa defatted seed meal.*

Sample	Protein concentrate %	Meal concentrate (g/g)	Protein yield (g/g)
Jojoba SDI	34^{d}	0.47^{b}	0.159^{d}
Jojoba SDII	36^{c}	0.45^{d}	0.162^{c}
Moringa SDI	55^{b}	0.50^{a}	0.275^{a}
Moringa SDII	58^{a}	0.46^{c}	0.267^{b}

Table 4. *Amino acids composition of defatted seed meal Jojoba and M. oleifera (g/100 g protein).*

Amino acids	Jojoba	*M. oleifera*
Leucine	6.24	7.43
Lysine	4.68	2.32
Threonine	1.43	4.15
Tryptophan	3.69	-
Isoleucine	4.73	4.38
Valine	4.32	7.24
Methionine	1.84	1.68
Tyrosine	3.68	2.38
Cysteine	1.47	1.21
Phenylalanine	5.34	5.42
Total essential amino acids	37.42	36.21
Serine	4.93	3.72
Proline	5.34	6.43
Glycine	8.32	12.61
Alanine	4.67	6.94
Arginine	5.74	5.37
Histidine	2.71	2.94
Glutamic	16.48	22.37
Aspartic	12.73	8.63
Total non-essential amino acids	60.92	69.01
Total amino acids	98.34	105.22

Chemical analysis of cupcakes

Tables 5 and 6 presents the values of the chemical analysis of cupcakes. The moisture content found increased in the cupcake with *Jojoba* and *Moringa* protein concentrate with a significant difference at $p<0.05$. Therefore, that absorption of water by the protein concentrates generally increased with temperature increased, the results revealed that the water absorption increased with the increasing levels of protein concentrate [25-29]. The determination of moisture is one of the most important measurements and is used in food analysis because it is related to its stability, quality and composition, and can affect the storage, packaging and processing.

The amount of protein found in the samples enriched with 75% *Jojoba* and *Moringa* protein had higher protein content (32 g) and the samples containing 50% *Jojoba* and *Moringa* protein had (8%) increasing in protein content (27 g). Also, samples with 25% protein concentrate of *Jojoba* and *Moringa* in the formulation of cupcakes that led to significantly increase in protein content (4%) (23 g). The values obtained in the analysis of lipids were 2.8% and 2.3% for the samples with 75% of *Jojoba* and *Moringa* protein concentrate respectively and (5.3%, 4.5% respectively) for samples with 50% *Jojoba* protein and *Moringa* protein with significant difference at $p<0.05$ when compared with those of control sample (10.2%). Thus it can be indicate that the products have relatively low lipid.

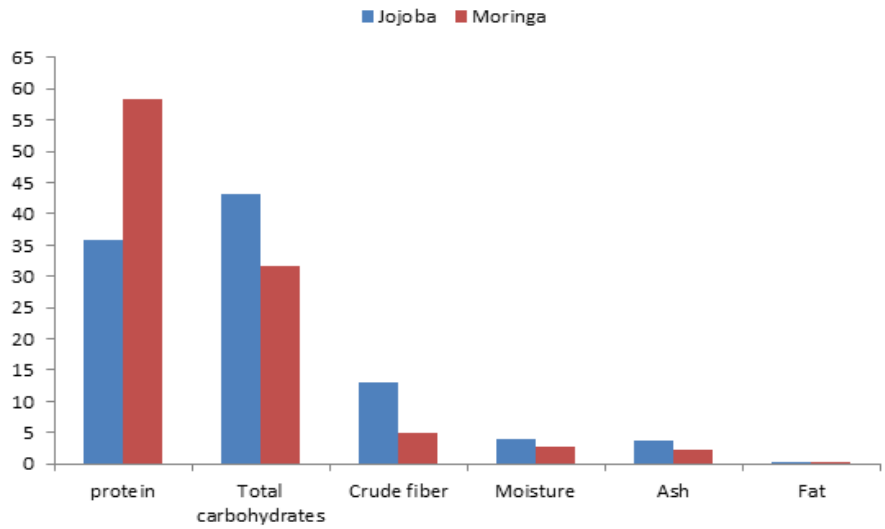

Figure 1. *Proximate composition (g/100 g) of Jojoba and Moringa defatted seed meal.*

Table 5. *Proximate composition (g/100 g) of cupcake with Jojoba defatted seed meal.*

Sample	Protein	Total carbohydrates	Crude fiber	Moisture	Ash	Fat
Control	19.6^{d}	52.5^{a}	1.3^{a}	15.4^{d}	1.07^{a}	10.2^{a}
Jojoba 25	23.4^{c}	49.8^{b}	1.3^{a}	16.3^{c}	1.06^{a}	8.1^{b}
Jojoba 50	27.6^{b}	46.1^{c}	1.3^{a}	18.7^{b}	1.09^{a}	5.3^{c}
Jojoba 75	32.1^{a}	40.5^{d}	1.3^{a}	22.1^{a}	1.14^{a}	2.8^{d}
Data are presented as means ± SD (n=3) and Means within a column with different letters are significantly different at (P ≤ 0.05)						

Physical characteristics

The effect of *Jojoba* and *Moringa* protein concentrate on cupcake physical properties was considered, data were illustrated in Table 7. Increasing of *Jojoba* and *Moringa* protein substitution level increased weight property. Accordingly, increasing either *Jojoba* or *Moringa* protein concentrate levels could bind more water led to increasing weight. Volume of cupcakes is affected by various factors such as quality of flour, type of ingredients and processing conditions. As for volume and specific volume characteristics, significant differences ($p<0.05$) were exhibited between all cupcakes [30-33]. The mean values for the volume of cupcakes indicated that the maximum value for volume was observed in control sample (107.35 cm^3) followed by *Jojoba* 25 and *Moringa* 25 while the minimum value was observed in *Jojoba* 75 and *Moringa* 75. Increasing protein concentrate levels could lead to decrease the volume and specific volume thinks to influence on gluten net with low strength and gas retention.

According to Table 7, the sample containing 75% concentrate protein from *Jojoba* and *Moringa* had the lowest specific volume. It should be noted that not only proteins have the ability to be a suitable fat replacer, but also they have the ability to strengthen the cell walls and do not allow the walls to be torn. The important point is that if we use excessive amount of additives in the formulation, it may hamper the air bubbles expansion during baking process due to the excessive increase in the strength of the their wall and therefore, not only there is no increase in volume of the final product texture, but also the texture is hard and compressed. In this study, the high levels of concentrate protein caused the same problem in low-fat cupcake.

Sensory characteristics

Figure 2 shows the interaction of concentrate protein of *Jojoba* and *Moringa* on the score given in sensory evaluation cupcakes produced samples. According to Figure 2, the highest smell, taste score was given to the sample containing 25 and 50% concentrate protein of *Jojoba* and *Moringa*. Also, it is more likely that reduction of sweet taste in the samples containing 75% concentrate protein, which was reported by the panelists, is affected by the undesirable taste. Since samples containing 75% concentrate protein had a hard, sticky and unswallow able texture comparing to the sample containing 25% and 50% of concentrate protein, an impaired release of flavor producers happens. Therefore, if an appropriate amount of *Jojoba* and *Moringa* concentrate protein are used during the process of replacing oil, besides having a desirable texture, flavor producers.

The results showed that form of the samples containing 25% concentrate protein were more superior to the other samples. The panelists expressed that the unexpectedly crumb and crust color of the sample containing 75% concentrate protein, was the main reason for the low rating. It should be noted, based on the panelists" decision, the sample containing 25% and 50% protein concentrate of *Jojoba* and *Moringa* was better than the sample containing 75% of it, in terms of upper surface characteristics. Because according to some sensory panelists, there can be seen tiny black particles on the surface of the sample containing 75% of protein concentrate that consequently, the desirability of the final product was reduced. On the other hand, the sample containing 25% *Jojoba* and *Moringa* protein was more superior to the control sample due to its brighter colored surface. On the other hand, a darker appearance is seen in the samples containing high levels of concentrate protein, which was unexpectable and considered as a burnt cupcake by the panelists. Also, there was a report on abnormal surface (sticky surface) that was apparently due to too much water absorption of the cupcake samples containing high level of protein used in the formulation of low-fat cupcake.

Table 6. *Proximate composition (g/100 g) of cupcake with M. oleifera defatted seed meal.*

Sample	Protein	Total carbohydrates	Crude fiber	Moisture	Ash	Fat
Control	19.6^{d}	52.5^{a}	1.3^{a}	15.4^{d}	1.07^{a}	10.2^{a}
Moringa 25	23.6^{c}	49.7^{b}	1.3^{a}	16.9^{c}	1.08^{a}	7.5^{b}
Moringa 50	27.8^{b}	46.2^{c}	1.3^{a}	19.1^{b}	1.14^{a}	4.5^{c}
Moringa 75	30.2^{a}	42.4^{d}	1.3^{a}	22.7^{a}	1.17^{a}	2.3^{d}
Data are presented as means ± SD (n=3) and Means within a column with different letters are significantly different at (P ≤ 0.05).						

Table 7. *Physical characteristics of cupcakes with Jojoba and Moringa protein concentrate.*

Sample	Weight (g)	Volume (cm^3)	Specific volume (cm^3/ g)
Control	41.18^{e}	107.35^{a}	2.61^{a}
Jojoba 25	41.94^{e}	107.04^{b}	2.55^{b}
Jojoba 50	43.47^{d}	105.73^{c}	2.43^{c}
Jojoba 75	46.72^{b}	102.92^{d}	2.20^{e}
Moringa 25	41.81^{e}	107.06^{b}	2.56^{b}
Moringa 50	44.37^{c}	105.68^{c}	2.38^{d}
Moringa 75	49.14^{a}	102.91^{d}	2.09^{f}
Means sharing the same letter in a column are not significantly different.			

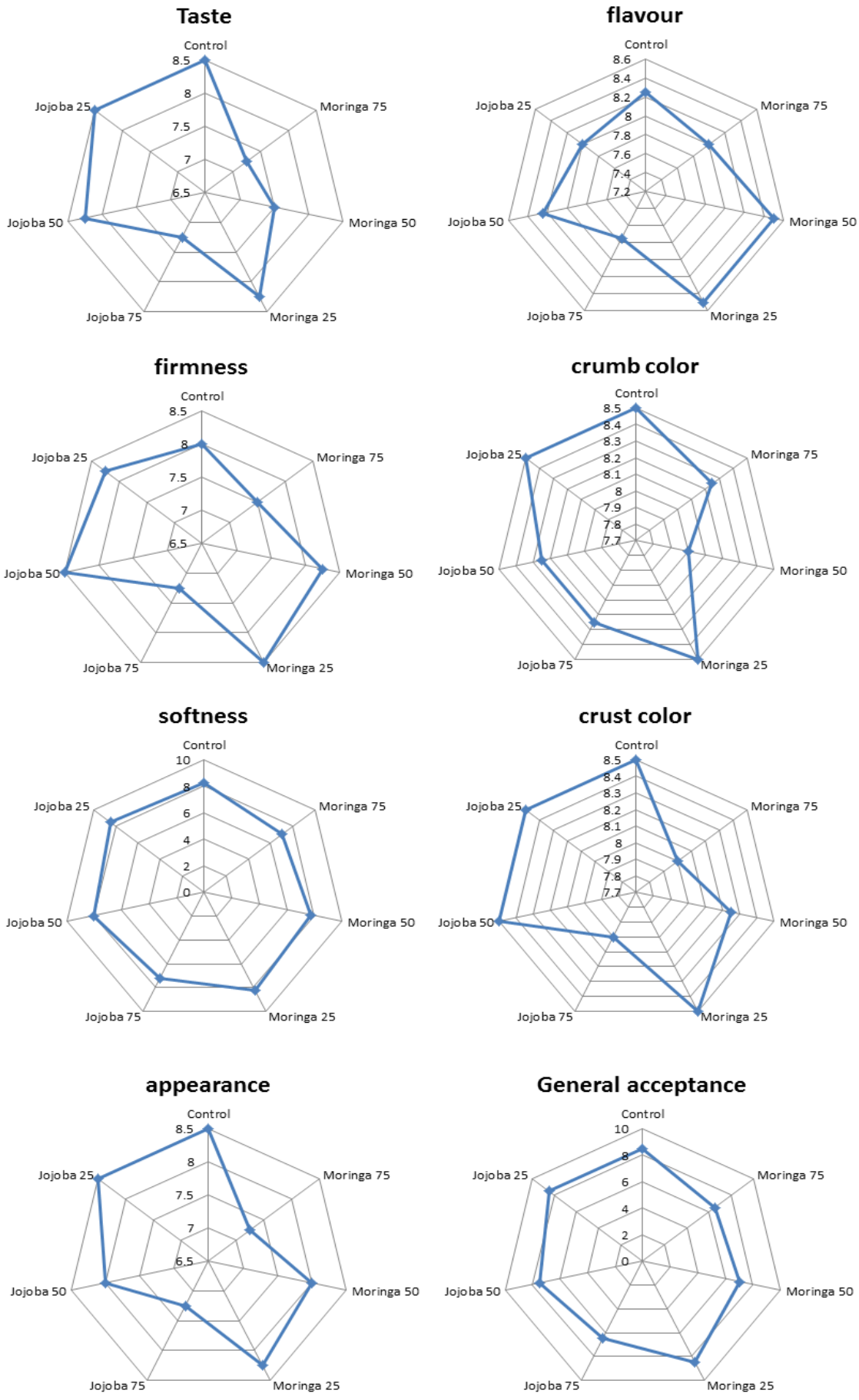

Figure 2. *Acceptance and purchase intent of cupcakes.*

According to the results of the evaluation of the texture of the low-fat cupcake samples, the sample containing 25% and 50% *Jojoba* and *Moringa* concentrate protein were given the high score on their texture qualitative properties, because this sample had the lowest amount of texture hardness than other samples. It was predicted that the sample containing 75% protein of *Jojoba* and *Moringa* receive the lowest scores regarding their softness and hardness.

According to results, the high overall acceptability was given to the sample containing 25% and 50% *Jojoba* and *Moringa* protein concentrate. Thus, since these two samples had the highest score in many parameters, it was expected that compared with other produced samples, their overall acceptability scores be at the highest level and the panelists introduced these two samples, as the samples of low-fat cupcake with high acceptable characteristics from the perspective of the consumer.

Conclusion

The results showed that with the increase of protein concentrate of *Jojoba* and *Moringa* contents, the general acceptance of the cupcake final products, we introduced the sample containing 25% protein concentrate of *Jojoba* and *Moringa* as the best sample. Then, the second level was acceptance in the study was content 50% of protein concentrates of *Jojoba* and *Moringa*. Based on the positive results of this study, the possibility to produce low-fat cupcakes with protein concentrate of *Jojoba* and *Moringa* with desired quantitative and qualitative properties is confirmed.

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