PHYSICOCHEMICAL AND SENSORY PROPERTIES OF PANCAKE ENRICHED WITH FREEZE DRIED DATE POMACE POWDER

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Abstract
Pancakes are starch-based products prepared by pouring batter onto a hot solid surface and cooking until solid. The main objective of this work is to evaluate physicochemical and sensory properties of pancake supplemented with freeze dried date pomace powder of Garn Ghzel date variety. Pancakes were prepared after incorporation of 20, 30 and 40% of freeze dried date pomace powder. Physicochemical and functional properties of different mixing powders used in formulations of pancake were characterized. Results showed that the incorporation rate of date pomace powder affected physicochemical and functional properties of different mixing powders (moisture, dry matter, ash, pH, titrable acidity, swelling index, true and bulk density), physicochemical characteristics (diameter, thickness, spread ratio, pre-cooking weight, post-cooking weight, volume, specific volume, number of cell, moisture, dry matter, ash, pH and titrable acidity) and sensory properties of pancake in terms of homogeneity of distribution, sweet taste, taste of date, Brown color, spongy appearance, sticky undertooth, crunchy undertooth, size of alveoli, date odor intensity were evaluated. All pancake samples were acceptable; however sample with 30% of date pomace powder was most preferred. Findings showed that good and acceptable pancake could be produced using date pomace powder at different levels.

Keywords: Pancake, Freeze dried, date pomace powder, physicochemical characteristics, functional properties, sensory evaluation.

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1. INTRODUCTION

Relation between food and health has an increasing impact on food innovation, due to the popularity of the concept of functional food. Practise of using nutrition knowledge at food product level to improve consumer health forms the general concept of functional foods (Kârklioà et al., 2012). Bakery products are consumed all over the world (Lu et al., 2010). Baked products are gaining popularity because of their availability, ready to eat convenience and reasonably good shelf life (Vijayakumar et al., 2013). Common bakery products include biscuit, muffin, cake, bread, pastries and pies (Paul and Bhattacharyya, 2015). Pancakes are starch-based products prepared by pouring batter onto a hot solid surface and cooking until solid (Pengy et al., 2016).
Pancakes consumed in Algeria are a product of family preparation. It is consumed on occasions and on holidays. Several names are given to this type of preparation such as Baghrir, Ghraif, Korsa etc. (Bouziane, 2014). The term "pancakes" refers to many preparations cooked traditionally in other countries of the world (Gocmen et al., 2009).
The use of fruit and vegetable by-products as natural food additives has recently been suggested, due to their high content of polyphenols, carotenoids, dietary fibre, or other bioactive compounds (Prokopov et al., 2015). Date *(Phoenix dactylifera)* is a highly energetic fruit. Typically date contains carbohydrate (44-88%), fat (0.2-0.5%), protein (2.3-5.6%), dietary fiber (6.4-11.5%), minerals such as potassium (650 mg/100g), iron (3 mg/100 g) and magnesium (75 mg/100 g) and vitamins such as vitamin B1, B2, A, riboflavin and niacin. Antioxidant potentials of dates have been also demonstrated (Fahloul et al., 2010). Date pomace is a by-product of date syrup industry. However, information on incorporation of date pomace powder in pancake is scarce.

The objectives of this work were to study the valorization of freeze dried date pomace powder and syrup of Garn Ghzel date variety by incorporation into pancake product and to determine its physicochemical and sensory properties.

2. MATERIALS AND METHODS

2.1. Preparation of date pomace powder

Date syrup was prepared according to Al-farsi (2003) method with a slight modification: A chopper was used to cut dates into pieces of 1 cm, then mixed with an equal amount of distilled water. The mixture was stirred for 20 min at 60°C in a water bath, (DK-420, China). Finally, the juice was extracted through a muslin cloth. Left material after juice extraction is called date pomace. It was freeze dried in a laboratory freeze dryer model (LD 2-8 CHRIST BETA PLUS, Germany) for 24 hours at a pressure and temperature of 0.12 mbar and -40°C respectively. Samples were ground and sieved in a sieve of 1mm diameter.

2.2. Pancake preparation

The pancake formula was adapted from the recipe of Shih et al. (2006) with some modifications. Pancake formula was shown in Table 1.

Table1. Formulation of pancake

Ingredient (g)	Control	P20	P30	P40
Semolina	97.7	78.32	68.39	58.62
Date pomace powder	0	19.38	29.31	39.08
Salt	2.0	2.0	2.0	2.0
Baking powder	4.2	4.2	4.2	4.2
Nonfat dried milk	15	15	15	15.0
Egg beaters	39.1	39.1	39.1	39.1
Distilled water	160	160	160	160

Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively.

Pancakes (Figure 2) prepared with 0%, 20%, 30% and 40% replacement of semolina with date pomace powder were designated as the control, P20, P30 and P40 respectively. Mixing of dry ingredients, including: semolina (97.7 g), salt (2.0 g), chemical baking powder (4.2 g) and nonfat dried milk (15.0 g), were added to distilled water (160g) and egg beaters (39.1 g) to make a batter. The later was mixed with a spatula for 45s, than with a mixer for 3 min and fermented at 42 ± 0.5°C for 60 min, Aisi 430 (Taiwan). 67.5g of the batter was homogenized and poured on the preheated commercial pancake maker (Crépemaber CM 2221 CB) at 170ºC. Cooking time was set to 2 min by assessing the surface color of pancake. The flow chart for the production of pancake is shown in Figure 1.

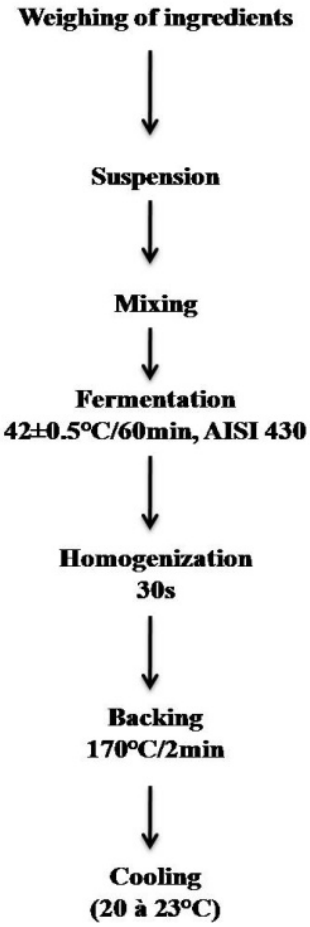

Figure 1: Flow chart for the production of pancake based on freeze dried date pomace powder

2.3. Physicochemical and functional characteristics of mixing powders

According to AOAC (1995), moisture and ash content of mixing powders were determined by gravimetric method at 105°C and incineration at 550°C respectively (Prokopov et al., 2015). pH and titrable acidity were determined

according to Kulkarni et al. (2008).

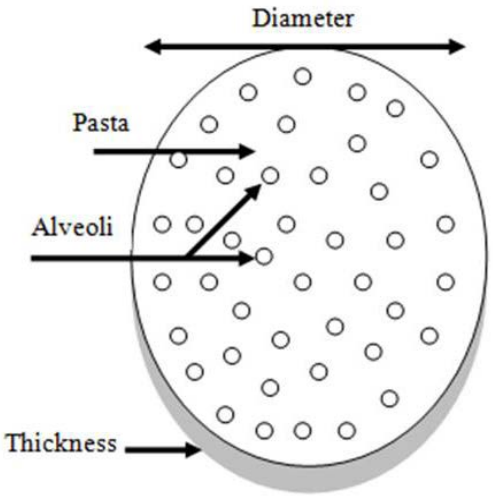

Figure 2: Descriptive diagram of pancake

Swelling index was determined according to Doukani (2015); weigh 50 g of sample and put in an empty test tube to measure volume (V1), then contents poured into a beaker filled with 200 ml of distilled water and leave to stand for 30 minutes. Then performing the reading of the obtained volume (V2). Swelling index is calculated according to the formula:

$$SI = \frac{V2}{V1} \quad (1)$$

SI: swelling index.
V1: dry sample volume (ml).
V2: wet sample volume after 30 min (ml).

True density of dry samples was determined as the ratio of the mass of dry solids (m) to total volume (Vs) excluding the air ports (Calín-Sánchez et al., 2014):

$$\rho_t = \frac{m}{Vs} \quad (2)$$

Samples were weighted with an analytical balance, (RADWAG, AS 220.R2, Poland) with reading accuracy of 0.0001g, while Vs was measured with a pycnometer model (ISO LAB In 20°C, 10ml BORO 3.3 A, Germany).

Bulk density of dried samples was determined as the ratio of solid mass to the bulk volume (Vb). and the bulk volume was measured with an 80 mL graduated container (Calín-Sánchez et al., 2014):

$$\rho_b = \frac{m}{Vb} \quad (3)$$

For color, samples were poured into Petri dishes, formed a layer of 10 mm thick and covered with a transparent film. The colorimeter, (KONICA MINOLTA SENSING, INC CR-10, Japan) was calibrated with a standard white ceramic plate before playback (L = 95.97, a = - 0.13, b = - 0.30). L is (lightness of the color zero (black) to 100 (white); a* value (degree of redness (0-60) or greenness (0 to -60); and b* (yellowing (0-60) or blueness (0 to - 60) were measured for all samples. The average value L, a* and b* were obtained from six readings for each sample (Abonyi et al., 2002).

2.4. Physicochemical properties of pancake

Diameter and thickness were measured using calipers in millimeters (Banusha and Vasantharuba, 2014). Spread ratio was calculated by dividing the average value of diameter by average value of pancake thickness (Baljeet et al., 2014). According to Rosa et al. (2015) with some modifications, weight was determined by weighing the raw Pancake before cooking, using a semi analytical balance (Kern, Imlab France). The same procedure was performed when the pancakes were baked, the readings recorded in grammes. Volume (cm^3) was measured by rapeseed replacement method described in the AACC (1983). Specific volume (volume to mass ratio) (cm^3/g) was there after calculated (Olubunmi et al., 2015).

$$\text{Specific volume} = \frac{\text{pancake volume}}{\text{pancake weight}} \quad (4)$$

The number of open cells per cm^2 was counted using a pancake with a known surface in five areas of each pancake (Bouziane, 2014).

$$ALV/cm^2 = \frac{\sum_{Z=1}^{5} alvz1 + alvez2 + alvz3 + alvz4 + alvz5}{16 \times 5} \quad (5)$$

z1, z2, z3, z4, z5: the five delimited areas;
Surface of a square shape: 16 cm^2.

The color of pancake was determined using Minolta chroma meter. Color value is based on L*(lightness–darkness), a*(redness–greenness) and b*(yellowness–blueness) according to the method of Rosa et al. (2015) with some modification.

Moisture, ash, pH and titrable acidity were obtained according to Kulkarni et al. (2008) and Prokopov et al. (2015).

2.5. Sensory evaluation

According to Rosa et al. (2015) with some modification; sensory evaluation was performed in order to evaluate differences among pancakes prepared with different amount of date pomace powders. It was performed using Twenty experienced staff members. They were selected according to willingness, availability, motivation and previously demonstrated capability to work as a member of a sensory panel. The affective test was used to evaluate the acceptability of pancakes in terms of homogeneity of distribution, sweet taste, taste of date, brown color, spongy appearance, sticky under tooth, crunchy under tooth, size of the alveoli and date odor intensity using a 9 - point hedonic scale, where the extremes corresponded to: 9=liked very much, and 1= disliked very much.

2.6. Statistical analysis

All analysis was performed with repetitions, and the results were expressed as the mean ± standard deviation (SD). Results were submitted to the analysis of variance (ANOVA) and the means were compared with Tukey's test using OriginPro 2016 32 Bit. Differences were considered to be significant at $P<0.05$.

3. RESULTS AND DISCUSSION

3.1. Physicochemical and functional characteristics of mixing powders

Changes in physicochemical and functional properties of mixing powders used in the formula of pancake were presented in Table 2. Moisture contents of control, P20, P30 and P40 powders were 11.64±0.15, 9.44±0.01, 9.25±0.08 and 8.24±0.08% respectively; incorporation rate of date pomace powder decreased the moisture content and increased the dry matter of mixing powders, these results are due to the low water content which characterizes date pomace powder. These results are supported by the findings of Reis et al. (2014) who reported that apple pomace has a moisture content 7.9%. Results obtained are also compared with values of semolina moisture around 14.5% (Barkouti, 2012). Ash content of mixing powders was not significantly different, decreased proportionally with incorporation rate of date pomace powder with values of 0.998, 0.995, 0.991 and 0.989% for control, P20, P30 and P40 respectively. Results showed that date pomace powder content in organic matter is higher than semolina. Results are compared with those of Sacchetti et al. (2011) concerning semolina with value of 0.88 (g/100 g_{dw}) and Kohajdová et al., (2012) who reported that the ash of carrot pomace powder is higher than fine wheat flour with values 1.39 and 0.40% respectively. pH of mixing powders decreased proportionally with increasing of mixed rate of date pomace powder with values of 6.42, 6.28, 6.17 and 6.11 for control, P20, P30 and P40 respectively. These results are related to mixed powders characteristics and incorporation rate and were similar to those reported by Pérez and Pérez (2009) for wheat semolina fettuccine and blend semolina with values of 6.35 and 6.43 respectively. Titrable acidity of mixing powders increased with the increasing of date pomace powder rate with values of 0.08, 0.5, 0.58 and 0.66 (Meqg/100 g of flour) for control, P20, P30 and P40 respectively. These results are due to mixing powders characteristics. Results were similar to those of Sall (1998) for wheat flour.

Swelling index (SI) of mixing powders ranged from 1.12 to 1.57. It depends on size particles, type of powders, solubility in water and date pomace powder content. Control samples had the highest value (1.57) and P40 had the lowest value (1.12), the SI decreases with the increase of date pomace powder incorporate. These results are lower than values given by Doukani (2015) for couscous products and acorn fruit with values of 2.10 and 3.43.

True and bulk densities of powders ranged from 625 to 645.16 and 555.55 to 609.75 kg/cm^3 for pancake preparation respectively; results obtained were lower than those reported

by Taufiq et al. (2015) for tamarind and pineapple powders. The difference is justified by the control type and the amount of incorporated date pomace powder; true and bulk densities of pancake preparation decreases with the increase of incorporated date pomace powder.

Table 2. Physicochemical and functional properties of different mixing powders

	Control	P20	P30	P40
Moisture (%)	11.64±0.15	9.44±0.01	9.25±0.08	8.24±0.08
Dry matter (%)	88.36±0.15	90.56±0.01	90.75±0.08	91,76±0.08
Ash (%)	0.998±0.00	0.995±0.00	0.991±0.00	0.989±0.00
pH	6.42±0.01	6.28±0.01	6.17±0.00	6.11±0.01
Titrable acidity (Meqg / 100 g of flour)	0.08±0.00	0.5±0.00	0.58±0.14	0.66±0.14
Swelling index	1.57±0.00	1.53±0.00	1.38±0.00	1.12±0.00
True density (Kg/m^3)	645.16±0.00	645.16±0.00	625±0.00	625±0.00
Bulk density (Kg/m^3)	740.74±0.00	666.66±0.00	694.44±0.00	645.16±0.00

Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively. Results are expressed as mean values of three determinations ± SD; analysis of variance (ANOVA) $p<0.05$ with Tukey's tests.

Color of mixing powders was affected by the incorporated rate of date pomace powder (Figure 3). In general, lightness (L*) of different mixing powders control, P20, P30 and P40 decreases with increasing of date pomace powder proportion and it was higher in powders intended for preparation of pancake. Redness (a*) increased with increasing of date pomace powder rate, and finally yellowness (b*) decreased with increasing of date pomace powders rate. Lightness and yellowness were higher in control samples. Redness of control powders samples was lower than other powders (P20, P30 and P40). L*, a* and b* components ranged from 71.9 to 81.6, 2.97 to 6.43 and 29.5 to 35.4 (Figure 3).

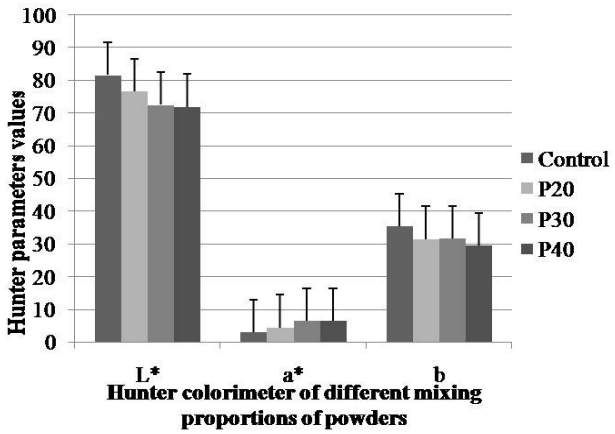

Figure 3: Color measurements of different mixing powders

Key: Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively.

These values are influenced by the level of incorporated date pomace powder. These results are supported with the values given by Makhlouf (2012) concerning L* and a* for taro sosso, the difference due to powders composition.

3.2. Physicochemical characteristics of pancake

Changes in pancake characteristics with date pomace powder are shown in Table 3. Evaluation of physical properties of enriched pancake showed that thickness in P30 was the highest and the lowest for the control. The result was due to the level of incorporated date pomace powder. Diameter for control, P20, P30 and P40 was 162.66, 165.66, 156.66 and 153.66 mm respectively. Addition of date pomace powder affected the viscosity of liquid paste of pancake during cooking, so the diameter decreases with the increase of incorporated date pomace powder. Results are compared to those reported by Banusha and Vasantharuba (2014) for wheat-malted flour blend biscuit. Spread ratio of control was the highest and for the P30 was the lowest; it was related to thickness and diameter of samples.

Table 3. Physicochemical characteristics of pancake prepared with date pomace powder

	Control	P20	P30	P40
Thickness (mm)	2.56±0.21	3.21±0.46	3.62±0.19	3.23±0.33
Diameter (mm)	162.66±1.52	165.66±0.21	156.66±2.89	153.66±2.08
Spread ratio	63.23±4.64	52.13±6.58	43.34±3.10	47.97±5.76
Pre-cooking weight (g)	67.5±0.00	67.5±0.00	67.5±0.00	67.5±0.00
Post-cooking weight (g)	50.03±0.06	48.67±0.06	50.53±0.06	53.37±0.06
Volume (cm^3)	35.33±4.40	36.5±3.32	35.26±4.41	27.26±3.36
Specific Volume (cm3 /g)	0.71±0.00	0.75±0.00	0.70±0.00	0.51±0.00
Moisture (%)	52.98±0.85	53.69±1.94	54.33±1.04	54.68±0.72
Dry Matter (%)	47.02±0.85	46.31±1.94	45.67±1.04	45.32±0.72
Ash (%)	0.974±0.00	0.975±0.00	0.977±0.00	0.977±0.00
pH	7.63±0.07	7.23±0.03	7.22±0.01	7.16±0.00
Titrable acidity (meqg/100g of product)	1.25±0.00	1.46±0.36	1.04±0.36	1.46±0.36

Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively. Results are expressed as mean values of three determinations ± SD; analysis of variance (ANOVA) $p< 0.05$ with Tukey's tests.

Spread ratio of pancake decreased from 63.23 to 43.34. Hence, results indicated that increasing of diameter and decreasing of thickness increase the spread ratio (Baljeet et al., 2014). Results showed that pre-cooking weight is similar for all samples (67.5g). The post-cooking weight ranged from 48.67 to 50.53g for P20 and P30 respectively. Silva et al. (2010) reported that this observation occurs because fibers absorb more water, which leads to an increase in yield in the formulation of baked products. Pancake volume ranged from 27.26 to 36.5, lower in P40 and higher in P20; it was the most important characteristic because it provides a quantitative measurement of baking performance and it is a good measurement of protein quality. Decrease in volume may be attributed to the dilution effect on the gluten network thereby reducing the gluten strength with a ripple effect of poor carbon dioxide gas formation and retention in the baked dough (Olubunmi et al., 2015). Specific volume was 0.71, 0.75, 0.70 and 0.51 for control, P20, P30 and P40 respectively. These results are compared with values of Bouziane (2014) for pancake; the difference is explained by the products preparation.

For moisture, approximate values are observed despite the difference in rate of date pomace powder; 52.98, 53.69, 54.33 and 54.68% for control, P20, P30 and P40 respectively. It increased with the increase of incorporated date pomace powder. Dry matter decreases with increasing of date pomace powder, results are consistent with those of Shih et al. (2006) regarding pancakes with values from 48.10 to 51.80%. Ash value varied from 0.974 to 0.977%, it increased with increase of incorporated date pomace powder, results were lower than those of Shih et al. (2006) for rice pancakes and wheat pancakes with values varied from 2.38 to 2.70. Cooking conditions and studied products affect the obtained results. pH level and titrable acidity ranged from 7.16 to 7.23 and 1.25 to1.46 meqg /100 g of product respectively. pH level decreased significantly upon addition of date pomace powders in contrast to titrable acidity as compared with results of Prokopov et al. (2015) for sponge cakes, date pomace powder supplementation resulted in production of pancake with neutral pH. Regarding titrable acidity, the results were lower than those reported by Yao et al. (2015) for l'attiéké product. Difference is due to the composition of each product.

The number of cell/m^2 of pancake prepared with date pomace powder was presented in Figure 4.

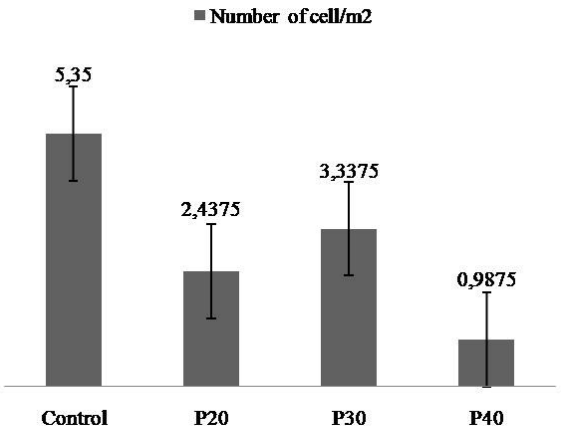

Figure 4: Number of cell/m^2 of pancake prepared with date pomace powder

Key: Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively.

The number of cell/m^2 for control, P20, P30 and P40 was 5.35, 3.34, 2.44 and 0.99 cell/m^2 respectively. Results showed that control sample has the higher value followed by P30, P20 and P40. These results are compared with those of Bouziane (2014) for pancake with values from 0.19 to 4.81 cell/cm^2, the difference is due to the fluidity of pastes defined by its initial formulation.

Color of bottom and upper surface of pancake fortified with date pomace powder was presented in Figure 5.

Color of bottom pancakes surface was affected by Maillard and caramelization reaction during baking, while the upper surface color was affected by the components used in the formulation, similar to results of Majzoubi et al. (2012) for cake product. Results indicated that L*, a* and b* are the following 71.33, 61.86, 58.6 and 58.46; 1.27, 5.43, 6.7 and 9.4; 34.93, 29.16, 28.87 and 27.8 for control, P20, P30 and P40 for bottom surface respectively.

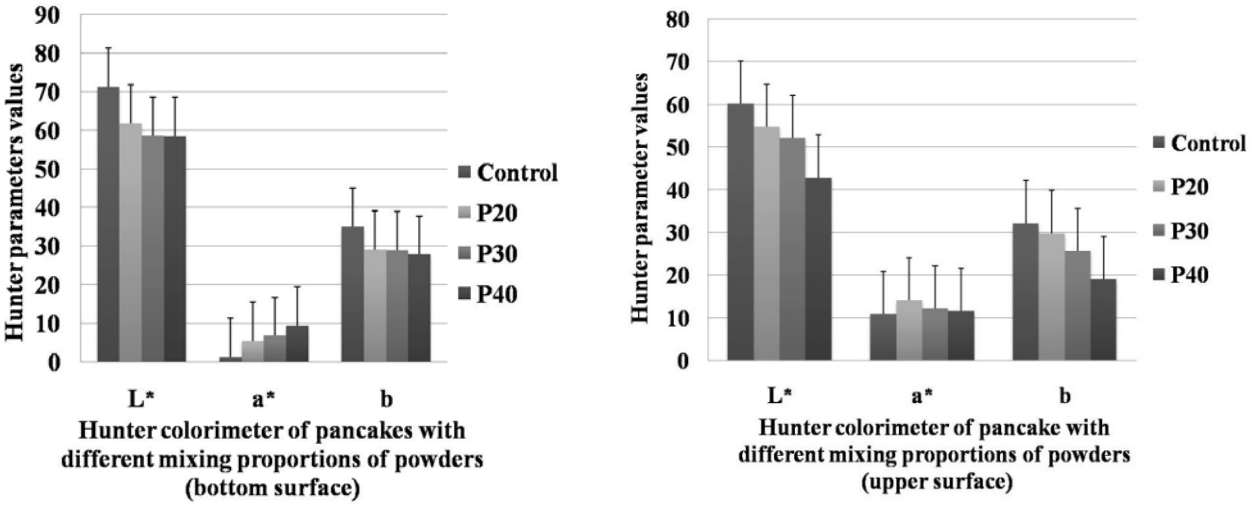

Figure 5: Color measurements of pancake product with different mixing proportions of powders (bottom and upper surface)

Key: Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively.

For upper surface the values obtained for L*, *a and b* are the following 60.20, 54.77, 52.13 and 42.83; 10.9, 14.13, 12.23 and 11.66; 32.2, 29.83, 25.66 and 19.13 concerning control, P20, P30 and P40 respectively. Lightness decreased with increasing date pomace powder for bottom and upper surface, redness increased with increasing date pomace powder for bottom surface, while for upper surface the values of redeness for control was less than P20, P30 and P40 and for yellowness decreased with increasing date pomace powder for bottom and upper surface. These are close to results found by Waldron et al. (2013) for pancake product.

3.3. Sensory evaluation

Web diagram for mean sensory scores of enriched date pomace powder pancake with Garn Ghzel date syrup was presented (Figure 6).

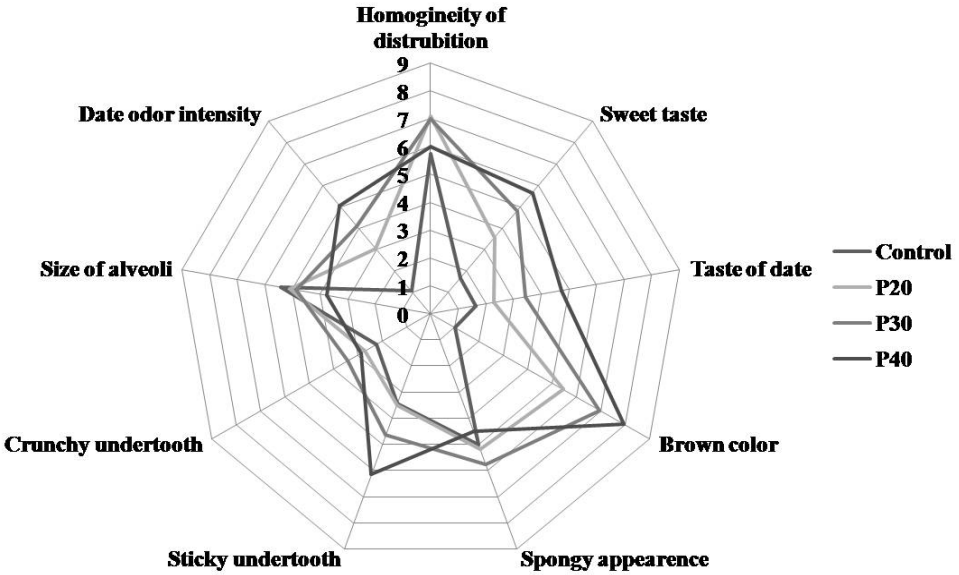

Figure 6. Web diagram for mean sensory scores of date pomace powder pancake with date syrup
Key: Control, P20, P30, and P40: prepared with 0%, 20%, 30% and 40% replacement of pancake semolina with date pomace powder, respectively.

Analysis was dependent on the composition of each sample; especially concentration of date pomace powder. According to sensory evaluation, the attributes (sweet taste, taste of date, brown color, sticky uander tooth and date odor intensity) for sample P40 had the highest score. For homogeneity of distribution, spongy appearance and size of alveoli, samples P20 and P30 had the highest score because concentration of date pomace powder (40, 20 and 30%) respectively. Overall acceptability of control, P20, P30 and P40 followed the same trend and all pancakes samples were acceptable. However, sample with 30% of date pomace powder was the most preferred.

4. CONCLUSION

The results of this study showed that it is possible to develop pancakes with Garn Ghzel date pomace powder. The Incorporation of freeze dried date pomace powder in the formulation of pancakes was found to improve physicochemical and functional properties of samples. Pancakes prepared at incorporation rates of 20%, 30% and 40% are all acceptable in terms of color, homogeneity of distribution, odor, taste, size of alveoli and spongy appearance. Pancake with 30% of date pomace powder was the most preferred.

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