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Incorporation of Antioxidant Enriched Almond Skin in Dried Apricot Jam

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INCORPORATION OF ANTIOXIDANT ENRICHED ALMOND SKIN IN DRIED APRICOT JAM

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ABSTRACT

Apricot occupies a distinct position among stone fruits due to its compositional and significant functional potentials. It has a rich nutritional contents in terms of sugars (more than 60%), proteins (8%), crude fiber (11.50%), crude fat (2%), total minerals (4%), vitamins and reasonable quantities of organic acids (citric acid and malic acid) on dry weight basis. This study aimed at active utilization of almond skin to enrich antioxidant activity of dried apricot jam and evaluation of its physicochemical, sensory and antioxidant attributes. Four jam formulations were developed, starting with the basic formulation (T_0/control) containing dried apricots. The other jams (T_1, T_2, T_3 and T_4) had dried apricots but with almond skin added at rates of 5, 10, 15 and 20% w/w. Antioxidant activity was observed in the skin of Kaghazi almonds by performing different analyses. The value of β–carotene was recorded as 98.3333±0.577μg g^{-1} in the peel. Moreover, DPPH value was also found as 86±1mg/ml in almonds peel. Total phenolic contents were recorded in peel as 0.54±1mgGAE/100g. Concerning the treatments, highest value of DPPH (21.883^{a}±0.035mg/ml) was observed in T_4 followed by DPPH (20.533^{b}±0.036mg/ml) of T_3. Conversely, minimum value of DPPH (17.413^{e}±0.106mg/ml) was recorded in T_0 (control). Highest value of total phenolic contents was observed in T_4 (521.35^{a}±0.169mgGAE/100g) and minimum value of total phenolic contents (514.65^{e}±0.349mgGAE/100g) was recorded in T_0 (control). Regarding the treatments, highest value of fiber (1.0833^{a}±0.006), moisture (88.600^{a}±0.1%), protein (1.4333^{a}±1.4%), pH (3.4133^{a}±0.012), total soluble solids (21.400^{a}±0.1^{0}Brix) and β-carotene (48.333^{a}±0.196%) was observed in T_4. The results suggests that almond peel can be added in to jam due to high TPC and DPPH which contribute to high antioxidant activity and high market potential.

Keywords: Apricot; compositional; physicochemical; antioxidant activity; total phenolic; Kaghazi almonds; Malic acid; DPPH; Nutritional; Citric acid

1. INTRODUCTION

The total area of apricot under cultivation in Pakistan is 31256 hectares with the total production of 240192 tones. The total area under cultivation in NWFP is 2313 hectares with the total production of 19680 tones. The total area under cultivation in Punjab is 42 hectares with the total production of 236 tones. The total area under cultivation in Balochistan is 28901 hectares with the total production of 220276 tones. The apricot is a member of the Rosaece family, along with peaches, plum, cherries and almonds. The word apricot comes from the Latin Praecocia meaning "early ripening" or "Precocious" [1].

Apricot occupies a distinct position among stone fruits due to its multifaceted compositional contour and significant functional potentials. It has a rich nutritional content in terms of sugars (more than 60%), proteins (8%), crude fiber (11.50%), crude fat (2%), total minerals (4%), vitamins (highly rich in vitamin A, C, K and B complex) and reasonable quantities of organic acids (citric acid and malic acid) on dry weight basis. Literature reports appreciable amounts of total phenolic and flavonoids in the fruit which make them more valuable as functional food. The fruit has a great market value as fresh and dried food commodity and has the highest market share of agricultural income in Gilgit-Baltistan province of Pakistan. Dried fruits are taken as an energy rich food in the mountainous Karakoram region and have many uses in folk medicine for treatment of cold, fever, cough and constipation. Owing to its bioactive components of pharmacological importance, it has been found effective against chronic gastritis, oxidative intestinal damage, hepatic steatosis, atherosclerosis, coronary heart disease and tumor formation [2].

Almond skin is also a rich source of antioxidants that includes catechin, protocatechuic acid, vanillic acid, p-hydroxybenzoic acid and quercetin. Moreover, some flavonois are also present in almond skin like isorhamnetin, kaempferol 3-O-rutinoside, isorhamnetin 3-O-glucoside, and morin [3]. On the basis of high antioxidant properties of almond skin, the objective of the current research is the addition of almond peel in the dried apricot jam to enhance its antioxidant properties.

2. MATERIALS AND METHODS

2.1. Procurement of raw materials and chemicals

Almond variety (Kaghzi) and dried apricots were purchased from local market of Faisalabad, Pakistan. Glass wares and required chemicals were purchased from Sigma Aldrich (Sigma Aldrich, Tokyo, Japan) and Merk (KGaA Merk Darmstadt, Germany).

2.2. Determination of antioxidant activity

Antioxidant activity of the skin of almond variety (Kaghzi) was determined by analyzing the total phenolics, free radical scavenging activity and β-carotene bleaching assay. Antioxidant activity of almond skin was also analyzed by β-carotene/linoleic acid method, as illustrated by Lertittikul [4].

DPPH radical-scavenging activity was determined by following the method described by Lertittikul [4]. Two milliliters of methanolic solution of DPPH (0.1 mM) was mixed with 2 ml of extract solution (1 mg/ml) and made up with methanol to a final volume of 3 mL. After 40 min standing at room temperature, the absorbance of the mixture was measured at 517 nm against methanol as blank using spectrophotometer. Quercetin (0.5 mg/ml) was used as positive reference compound. Distilled water was used in place of sample solution as control. The DPPH free radical scavenging activity was calculated. The results were expressed as percentage inhibition of the DPPH free radical. The percentage of DPPH scavenging activity was analyzed as follows:

$$\text{Scavenging activity } \% = \left(1 - \frac{A1}{A0}\right) \times 100$$

Where A_0 – absorbance of the blank (methanol replacing the extract) A_1– absorbance in the presence of the sample extract

The content of total phenolics was determined colorimetrically using Folin-Ciocalteus's phenol reagent. Sample was prepared by mixing 0.4 ml extract (10 mg/ml) with 0.4 ml of Folin–Ciocalteu reagent (50% v/v) and 2 ml sodium carbonate (15%). Sample was diluted with deionised water (1.2 ml) prior incubation for 2 h at room temperature. Six concentrations of gallic acid (GA) standard solution ranging from 0.1 to 0.6 mg/ml were prepared to obtain the standard calibration curve. Absorbance of each sample was measured at 760 nm using UV-Vis Spectrophotometer. All tests were performed three times and averaged. Total phenolic content of the extract was expressed as milligrams of gallic acid equivalents (GAE) per 1 g of dry plant extract.

The AOAC [7] method was used for determining β-carotene by a spectrophotometric assay. To obtain the calibration curve, the β-carotene standard was used. Next, the β-carotene content was calculated on the base of the calibration curve and data were expressed as mg β-carotene 100 g^{-1}fw.

2.3. Drying of Almond by-product

Almonds were purchased from Local market of Faisalabad, Pakistan. Almonds were soaked overnight in water or 8-12 hours. Then removed the skin of almonds. Almond skin was oven-dried to make the powder. Moreover, sun-drying was also used for the purpose.

2.4. Preparation of dried apricot jam

Dried apricot was purchased from Local Market of Faisalabad, Pakistan. Dried apricot jam was prepared by adopting the method of Awolu [5]. Different treatments of dried apricots jam were prepared by using various concentrations of almond skin. The treatment plan for using various concentrations of almond skin is given in Table 1.

Table 1: Dried apricot jam preparation by using different concentrations of almond skin

Treatments	Almond skin concentration (%)
T_0	0
T_1	5
T_2	10
T_3	15
T_4	20

2.5. Physico-chemical analysis of dried apricots jam

Dried apricots jam was used to determine the moisture, fat, protein, fiber and ash as described in AACC [6].

2.6. pH determination

pH of different jam treatments was done by using pH meter according to the method described in AACC [6].

2.7. Total soluble solids determination

Total soluble solids (^{0}Brix) were measured by standard method of AOAC [7] using Abbe's refractometer at room temperature.

2.8. Antioxidant activity determination

Antioxidant activity of apricot jam was determined by analyzing total phenolics, radical scavenging activity and β-carotene bleaching assay as the methods mentioned above.

2.9. Organoleptic evaluation of jam

The organoleptic analysis of samples was done by following the method of Fasogbon [8]. The samples were assessed for aroma/ flavour, colour, taste, texture/ spread ability and general acceptability using a five-point hedonic scale where five represents 'like extremely' and 1 represents 'dislike extremely'.

2.10. Statistical analysis

The physico-chemical data of different treated dried apricots jams were analyzed by one-factor factorial Completely Randomized Design according to the method of Montogmery [9]. Means were analyzed through Least Significant Difference.

3. RESULTS

3.1. Antioxidant activity of almond skin

Antioxidant activity was observed in the skin of Kaghazi almonds by performing different analyses. The value of β–carotene was recorded as 98.3333±0.577% in the peel. Moreover, DPPH value was also found as 86±1% in Kaghazi almonds. Total phenolic contents were recorded in Kaghazi as 0.54±1mgGAE/100g.

3.2. Ash and fat contents of dried apricot jam

The null hypothesis was the application of different treatments does not affect the ash and fat contents of dried apricot jam. Mean squares showed highly significant effects of treatments on ash and fat contents of apricot jam, so the null hypothesis was rejected.

High value of ash contents was observed in T_4 (Table 2). However, minimum value was observed in T_0 (control). Regarding the treatments, highest value of ash contents was observed in T_4 (0.7867^{a}±0.006%) followed by ash contents of T_3 (0.7767^{b}±0.006%). Conversely, minimum value of ash contents (0.7233^{e}±0.006%) was recorded in T_0 (control).

High value of fat was observed in treatments containing treated dried apricot jam (Table 2). However, control contained minimum value of fat in jam. Concerning the treatments, highest value of fat (0.0733^{a}±0.006%) was observed in T_4 followed by fat (0.0633^{a}±0.006%) of T_3. Conversely, minimum value of fat (0.0267^{c}±0.006%) was recorded in T_0 (control).

Table 2: Ash and fat in treatments of dried apricot jam

Treatments	Ash (%)	Fat (%)
T_0	0.72^{e}±0.006	0.03^{c}±0.006
T_1	0.74^{d}±0.006	0.04^{bc}±0.006
T_2	0.87^{c}±0.006	0.05^{b}±0.006
T_3	0.88^{b}±0.006	0.06^{a}±0.006
T_4	0.89^{a}±0.006	0.07^{a}±0.006

Means carrying the same letters are not significantly different

T_0= Control dried apricot jam (without almond skin)

T_1= 5% almond skin in dried apricot jam

T_2= 10% almond skin in dried apricot jam

T_3= 15% almond skin in dried apricot jam

T_4= 20% almond skin in dried apricot jam

Means carrying the same letters are not significantly different

T_0= Control dried apricot jam (without almond skin)

T_1= 5% almond skin in dried apricot jam

T_2= 10% almond skin in dried apricot jam

T_3= 15% almond skin in dried apricot jam

T_4= 20% almond skin in dried apricot jam

3.3. Fiber and moisture contents of dried apricot jam

Highest moisture content of 85.20% was observed in frozen CITH-2 at the 0 month of storage while as lowest (11.20%) was observed in dried CITH-2 apricots at 0 month of storage.

The null hypothesis was the application of different treatments does not affect the fiber, moisture contents and protein of dried apricot jam. Mean squares showed highly significant effects of treatments on fiber and moisture contents of apricot jam, so the null hypothesis was rejected.

High value of fiber contents was observed in T_4 (Table 3). However, minimum value was observed in T_0 (control). Regarding the treatments, highest value of fiber contents was observed in T_4 (1.0833^{a}±0.006%) followed by T_3 (1.0633^{b}±0.006%). Conversely, minimum value of fiber contents (1.0167^{d}±0.006%) was recorded in T_0 (control).

High value of moisture contents was observed in treatments containing treated dried apricot jam (Table 3). However, control contained minimum value of moisture in jam. Concerning the treatments, highest value of moisture (88.600^{a}±0.1%) was observed in T_4 followed by moisture (86.467^{b}±0.115%) of T_3. Conversely, minimum value of moisture contents (83.300^{e}±0.1%) was recorded in T_0 (control).

High value of protein was observed in treatments containing treated dried apricot jam (Table 3). However, control contained minimum value of protein in jam. Concerning the treatments, highest value of protein (1.4333^{a}±1.4%) was observed in T_4 followed by protein (1.2667^{b}±0.058%) of T_3. Conversely, minimum value of protein (0.8667^{d}±0.081%) was recorded in T_0 (control).

Table 3: Fiber, moisture and protein in treatments of dried apricot jam

Treatments	Fiber (%)	Moisture (%)	Protein (%)
T_0	1.02^{d}±0.006	83.30^{e}±0.1	0.97^{d}±0.081
T_1	1.03^{c}±0.006	84.67^{d}±0.12	1.03^{c}±0.068
T_2	1.15^{b}±0.006	85.87^{c}±0.06	1.27^{b}±0.068
T_3	1.16^{b}±0.006	86.467^{b}±0.12	1.37^{b}±0.068
T_4	1.18^{a}±0.006	88.60^{a}±0.1	1.43^{a}±1.4

3.4. pH and total soluble solids of dried apricot jam

The null hypothesis was the application of different treatments does not affect the pH and total soluble solids of dried apricot jam. Mean squares showed highly significant effects of treatments on pH and total soluble solids of apricot jam, so the null hypothesis was rejected.

High value of pH was observed in T_4 (Table 4). However, minimum value was observed in T_0 (control). Regarding the treatments, highest value of pH was observed in T_4 ($3.4133^{a}\pm0.012$) followed by T_3 ($3.4033^{a}\pm0.006$). Conversely, minimum value of pH ($3.3367^{d}\pm0.006$) was recorded in T_0 (control).

High value of total soluble solids was observed in treatments containing treated dried apricot jam (Table 4). However, control contained minimum value of total soluble solids in jam. Concerning the treatments, highest value of total soluble solids ($21.400^{a}\pm0.1^{0}$Brix) was observed in T_4 followed by total soluble solids ($20.533^{b}\pm0.251^{0}$Brix) of T_3. Conversely, minimum value of total soluble solids ($17.400^{e}\pm0.1^{0}$Brix) was recorded in T_0 (control).

Table 4: pH and TSS in treatments of dried apricot jam

Treatments	pH	TSS (°Brix)
T_0	$3.34^{d}\pm0.006$	$17.40^{e}\pm0.1$
T_1	$3.46^{c}\pm0.006$	$18.36^{d}\pm0.15$
T_2	$3.48^{b}\pm0.006$	$19.20^{c}\pm0.1$
T_3	$3.40^{a}\pm0.006$	$20.53^{b}\pm0.25$
T_4	$3.41^{a}\pm0.012$	$21.40^{a}\pm0.1$

Means carrying the same letters are not significantly different

T_0= Control dried apricot jam (without almond skin)

T_1= 5% almond skin in dried apricot jam

T_2= 10% almond skin in dried apricot jam

T_3= 15% almond skin in dried apricot jam

T_4= 20% almond skin in dried apricot jam

Means carrying the same letters are not significantly different

T_0= Control dried apricot jam (without almond skin)

T_1= 5% almond skin in dried apricot jam

T_2= 10% almond skin in dried apricot jam

T_3= 15% almond skin in dried apricot jam

3.5. β-carotene, DPPH and TPC of dried apricot jam

The null hypothesis was the application of different treatments does not affect the β-carotene, DPPH and TPC of dried apricot jam. Mean squares showed highly significant effects of treatments on β-carotene, DPPH and TPC of apricot jam, so the null hypothesis was rejected.

High value of β-carotene was observed in T_4 (Table 5). However, minimum value was observed in T_0 (control). Regarding the treatments, highest value of β-carotene was observed in T_4 (48.333^{a}±0.196%) followed by T_3 (46.367^{b}±0.306%). Conversely, minimum value of β-carotene (40.500^{e}±0.1%) was recorded in T_0 (control).

High value of DPPH was observed in treatments containing treated dried apricot jam (Table 5). However, control contained minimum value of DPPH in jam. Concerning the treatments, highest value of DPPH (21.883^{a}±0.035%) was observed in T_4 followed by DPPH (20.533^{b}±0.036%) of T_3. Conversely, minimum value of DPPH (17.413^{e}±0.106%) was recorded in T_0 (control).

High value of total phenolic contents was observed in T_4 (Table 5). However, minimum value was recorded in T_0 (control). Regarding the treatments, highest value of total phenolic contents was observed in T_4 (521.35^{a}±0.169mgGAE/100g) followed by T_3 (519.44^{b}±0.067mgGAE/100g). On the other hand, minimum value of total phenolic contents (514.65^{e}±0.349mgGAE/100g) was recorded in T_0 (control).

Table 5: β-carotene, DPPH and TPC of dried apricot jam

Treatments	β-carotene (%)	DPPH (%)	TPC (mgGAE/100g)
T_0	40.50^{e}±0.1	17.41^{e}±0.10	514.75^{e}±0.35
T_1	42.53^{d}±0.20	18.47^{d}±0.15	516.36^{d}±0.12
T_2	44.32^{c}±0.11	19.97^{c}±0.04	518.20^{c}±0.07
T_3	46.47^{b}±0.30	20.53^{b}±0.03	519.44^{b}±0.07
T_4	48.33^{a}±0.19	21.98^{a}±0.03	521.45^{a}±0.27

3.6 Organoleptic evaluation of dried apricot jam

The null hypothesis was the application of different treatments does not affect the flavor, color, taste, texture and overall acceptability of dried apricot jam. Mean squares showed highly significant effects of treatments on flavor, color, taste, texture and overall acceptability of apricot jam, so the null hypothesis was rejected.

High value of flavor was observed in T_0 (Table 6). However, minimum value was observed in T_4 (5.333^{c}±0.577). Regarding the treatments, highest value of flavor was observed in T_0 (8.333^{a}±0.577) followed by T_1 (7.667^{a}±0.577) and T_2 (7.333^{ab}±0.577).

High value of color was observed in control sample of dried apricot jam (Table 6). However, T_4 (20% almond skin in dried apricot jam) contained minimum value of color in jam. Concerning the treatments, highest value of color ($7.667^{a}\pm0.577$) was observed in T_0 followed by color ($7.333^{a}\pm0.577$) of T_1 and T_2 ($6.667^{ab}\pm0.577$). Conversely, minimum value of color ($4.667^{c}\pm0.577$) was recorded in T_4.

High value of taste was observed in T_0 (Table 6). However, minimum value was recorded in T_4. Regarding the treatments, highest value of taste was observed in T_0 ($8.333^{a}\pm0.577$) followed by T_1 ($7.667^{ab}\pm0.577$) and T_2 ($7.667^{ab}\pm0.577$). On the other hand, minimum value of taste ($5.667^{c}\pm0.577$) was recorded in T_4 (20% almond skin in dried apricot jam).

High value of texture was observed in T_0 (Table 6). However, minimum value was observed in T_4. Regarding the treatments, highest value of texture was observed in T_0 ($8.333^{a}\pm0.577$) followed by T_1 ($7.667^{a}\pm0.577$) and T_2 ($7.333^{a}\pm0.577$). Conversely, minimum value of texture ($5.333^{b}\pm0.577$) was recorded in T_4.

High value of overall acceptability was observed in control sample of dried apricot jam (Table 6). However, T_4 contained minimum value of overall acceptability in jam. Concerning the treatments, highest value of overall acceptability ($7.667^{a}\pm0.577$) was observed in T_0 (control) followed by overall acceptability of T_1 ($7.333^{a}\pm0.577$) and T_2 ($6.667^{ab}\pm0.577$). Conversely, minimum value of overall acceptability ($4.333^{c}\pm0.577$) was recorded in T_4.

So, it was concluded that T_2 (10% almond skin in dried apricot jam) was the best treatment on the basis of analysis of physico-chemical, antioxidant and organoleptic characteristics of jam.

Table 6: Flavor, color, taste, texture and overall acceptability in treatments of dried apricot jam

Treatments	Flavor	Color	Taste	Texture	Overall acceptability
T_0	$8.33^{a}\pm0.68$	$7.77^{a}\pm0.68$	$8.33^{a}\pm0.68$	$8.33^{a}\pm0.68$	$7.77^{a}\pm0.68$
T_1	$7.57^{a}\pm0.68$	$7.33^{a}\pm0.68$	$7.77^{ab}\pm0.68$	$7.77^{a}\pm0.68$	$7.33^{a}\pm0.68$
T_2	$7.33^{ab}\pm0.68$	$6.77^{ab}\pm0.68$	$7.77^{ab}\pm0.68$	$7.33^{a}\pm0.68$	$6.77^{ab}\pm0.68$
T_3	$6.33^{bc}\pm0.68$	$5.77^{bc}\pm0.68$	$6.77^{bc}\pm0.68$	$5.77^{b}\pm0.68$	$5.77^{b}\pm0.68$
T_4	$5.33^{c}\pm0.68$	$4.55^{c}\pm0.68$	$5.77^{c}\pm0.68$	$5.33^{b}\pm0.68$	$4.33^{c}\pm0.68$

4. DISCUSSION

4.1. Antioxidant activity of almond skin

DPPH, a violet color stable organic free radical, shows absorption maximum around 515 to 528 nm. Upon receiving proton from hydrogen donor substances such as phenolics, it loses its chromophore and changes into yellow color. With the increase in concentration of phenolic compounds or the degree of hydroxylation of the phenolic

compounds, DPPH free radical scavenging capacity and thus antioxidant activity increases. DPPH scavenging activity for almond extracts varied widely ranging from 12.15 to 18.22% in case of thick shell and 15.32 to 57.9% in case of thin shell extracts, according to sarwar [10]. DPPH value in almond skin is 0.20 mg/mL, the IC50 value of ascorbic acid was 0.07 mg/mL, respectively, are described by Tian et al. (2011). Retention of *β-carotene* in a *β-carotene-linoleate* model system by almond whole seed, brown skin and green shell cover extracts was 84-96, 74-83 and 71-93% respectively, according to Esfahlan [12].

4.2. Ash and fat contents of dried apricot jam

The above results of the ash and fat contents are found as 0.43% and 0.22%, respectively. The results of protein in almond and apricot jam 0.42%, while protein content was observed to be greater than cassava and potato starch (0.06%) but lower than sago (0.64%) and corn (0.73%) starch and amylose content was found as 15.2% in almond and apricot jam, are described by Nawab [13]. The jam shows the moisture is 33.58 ± 0.1 g/(100 g), ash contents are 0.37 ± 0.0 g/(100 g), and crude protein, 0.38 ± 0.0 g/(100 g), are described by Anuar [14].

4.3. Fiber and moisture contents of dried apricot jam

The moisture content of jam is 33.58 ± 0.1 g/(100 g) and result of crude fiber is 0.59 ± 0.0 g/(100 g), are described by Anuar [14]. Result moisture of jam showed that it contained 78.00%, 77.04% and 76.01%. The mean value was recorded as 77.01%, the maximum increase was recorded as 78.00% and minimum increase was recorded as 76.01%, are described by Kamal [15].

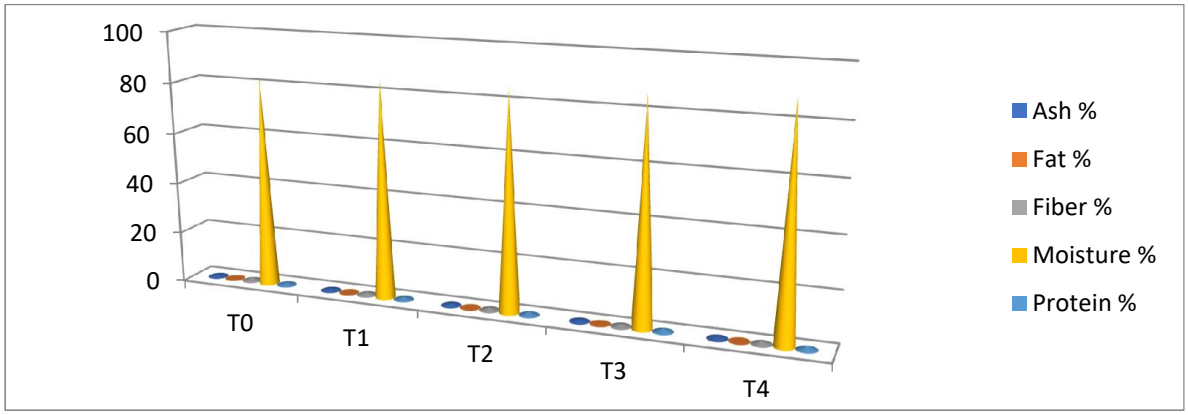

Figure 1. The effect of addition of antioxidant rich almond skin on ash, fat, fiber, moisture and protein in dried apricot jam

4.4. pH and total soluble solids of dried apricot jam

Result regarding pH of jam showed that it contained 3.70, 3.69 and 3.68. The mean value was recorded as 3.69. The maximum increase was recorded as 3.70 and minimum increase was recorded as 3.68. Result regarding total Soluble Solids of jam showed that it contained 21.1%, 21.3% and 21.7%. The mean value was recorded as 21.3%.

The maximum increase was recorded as 21.7% and minimum increase was recorded as 21.1%, are described by Kamal [15].

The pH values of jam decreased significantly after jam processing from 3.66 to 3.31 and decreased during storage from 3.31to3.20.The reduction of pH values could be due to formation of hydroxymethylfurfural (HMF) by hydration of sugar during processing and storage which lead to conversion of HMF into levulinic and formic acids, according to Rababah et al. (2011). The TSS is primarily represented by sugars, with acids and minerals contributing. According to the Codex Alimentarius standard (CODEXSTAN) [17]., normal fruit conserves or preserves must contain P60% soluble solids. The TSS changes were not significant ($p < 0.05$) by storage time, temperature or the interaction between those factors. The TSS values found in this work at different storage time and temperature, ranged between 64.42% and 67.30%, are described by Touati [18].

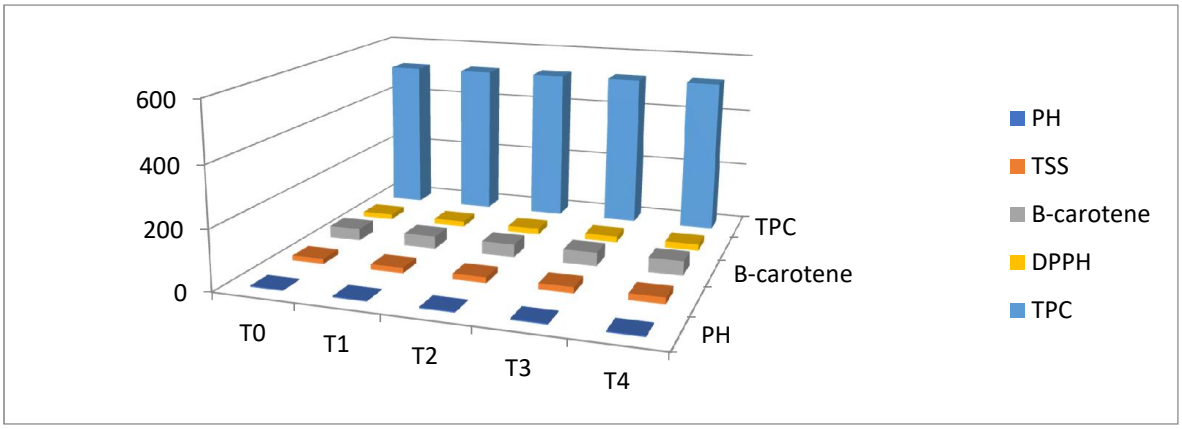

Figure 2. The effect of antioxidant rich almond skin on pH, TSS, β- carotene, DPPH and TPC

4.5. β-carotene, DPPH and TPC of dried apricot jam

β-carotene was the most abundant in all the samples analysed, with an average content of 1.98 µg·g–1 in the fresh fruits and, respectively, 1.61 µg·g–1 and 1.42 µg·g–1 in the jam, followed by Giuffrida [19]. The antioxidant activity by the DPPH method presented significant differences in the first 15 days, but not in the following days. Thus, lower antioxidant activity (EC50 = 3.94 µg/ml) was observed at the beginning compared to that after 60 days of storage (EC50 = 2.29 µg/ml); this result corresponds to an increase in 42% of the antioxidant activity in the product, showing high potential for the reduction of DPPH (ranging from 20% to 40%). EC50 values above 250 mg/ml indicate low potential antioxidants Thus, the jam itself presents as an excellent food source of bioactive compounds with antioxidant activity, according to Amorim [20]. Total phenolics of apricot jams ranged from 201.4to1859.7mgGAEkg−1. The results also showed that apricot fruit had significantly ($P < 0.05$) the highest amount of total phenolics and decreased significantly after jam processing (by 72.3%) followed by 1 and 2months of storage and no change after 3months of storage was observed, according to Rababah [15].

4.6. Organoleptic evaluation of dried apricot jam

The sensory profile of jam was evaluated in terms of color, aroma, taste, spread ability and overall acceptability; average score of sensory attributes during storage. Color is an important sensory attribute on which the consumer preference depends. Taste ranged from 3.8% - 4.6% with jam as lowest and control as highest. After taste ranged from 3.4% - 4.3% with jam as lowest and control as highest. Texture and spread ability ranged from 3.7% - 4.3%, and 3.5%-4.5% respectively with the control sample having the least and jam the highest in both cases. Good jam has a soft even consistency without distinct pieces of fruit, a bright color, a good fruit flavor and a semi-jellied texture that is easy to spread but has no free liquid, according to Rana [21]. Sensory evaluation of almonds and apricot jam was carried out by a panel of 30 judges using 9-point hedonic scale, are described by Nawab [13]. So, the addition of almond peel increases the antioxidant activity of dried apricot jam.

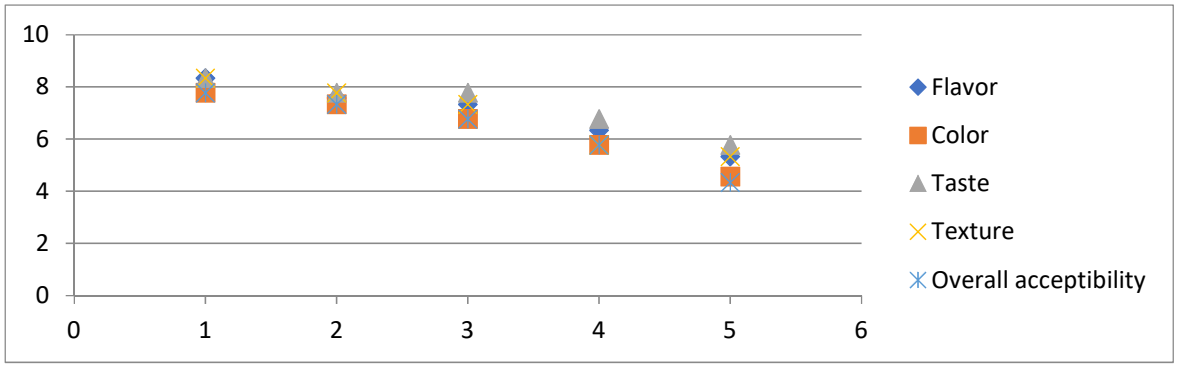

Figure 3. The effect of antioxidant rich almond skin on sensory properties of dried apricot jam

5. Conclusion

Economically significant project as the almond waste item (skin) will be further used to enhance the antioxidant properties of jam. Antioxidant activity of dried apricot jam will be enhanced.

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7. FOOT NOTES

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