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THE QUALITY OF APPLE JAM PRODUCTS FORTIFIED WITH NATURAL HERBAL EXTRACTS

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ABSTRACT

Honey is a healthy food with various benefits for human health and nutrition. Herbs have long been used as flavoring agents and preservatives due to their antimicrobial activity against certain pathogens and their antioxidant properties. The objective of this study was to assess the impact of incorporating specific herbal extracts, namely sweet basil *(Ocimum basilicum)* and ginger *(Zingiber officinale*), as well as substituting sugar with bees honey, on the physicochemical, microbial, and sensory properties of apple jam during a 6-month of storage period at room temperature (25ºC±5ºC). The findings revealed that apple jam with 1.5% sweet basil aqueous extract and honey showed the highest content of antioxidants, phenols, and flavonoids. Substituting sugar with honey improved sensory properties compared to the control. Additionally, the incorporation of sweet basil and ginger aqueous extracts and the replacement of sugar with honey had the most significant effect in reducing the total bacterial count of the apple jam samples during the storage period. In conclusion, using sweet basil and ginger aqueous extracts and substituting sugar with honey not only extended the shelf life of apple jam but also enhanced its nutritional and health-related values.

INTRODUCTION

Fruits and vegetables play a vital role in human nutrition. However, their perishable nature often leads to significant postharvest losses, estimated to range from 25% to 80% **(Rajauria and Tiwari, 2018).** These losses result largely from inadequate processing and preservation methods **(Thirupathi *et al.*, 2006; Shurekha *et al.*, 2010).** To mitigate these losses, preservation techniques and the use of preservatives are employed in various fruit preserves, such as jam, which involves cooking fruit pulp with sugar (sucrose), pectin, acid, and additional ingredients like preservatives, coloring agents, and flavouring materials **(Basu *et al.*, 2011).**

Recently, natural sweeteners have gained attention as sugar substitutes. Honey, in particular, serves as a good source of antioxidants and acts as free radical scavenger, reducing the formation or neutralizing free radicals **(Ghosh *et al.*, 2022).** Honey is a healthy foodstuff promoting better human health and nutrition **(Kumar *et al.*, 2010).** Honey-related products include bee pollen, beeswax, organic honey, royal jelly, mead, and bee bread. It also possesses attractive chemical properties for baking and imparts a distinctive flavour when used as a sweetener. Furthermore, honey does not spoil, even after thousands of years, as most microorganisms do not grow in it **(Ghosh *et al.*, 2022).**

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Apple (*Malus domestica*) is the chief tree fruit globally from Southwestern Asia. It contains approximately 84.7% water, 13.9 g carbohydrates, 0.3 g lipids, 0.4 g protein, and 8 mg vitamin C per 100 g of edible fruit. Apples are rich sources of antioxidants, particularly flavonoids and polyphenols, mainly found in the skin. Therefore, consuming the whole apple is recommended to obtain its full health benefits **(Hussain, 2001).**

Herbs have been used as flavouring agents and preservatives due to their antimicrobial activity against certain pathogens and their antioxidant properties **(Rajauria and Tiwari, 2018).** Sweet basil (*Ocimum basilicum*) is a plant known for its antimicrobial, antioxidant, and medicinal properties, significantly contributing to human health **(Brandi *et al.*, 2006).** In India, it is traditionally used as a spice product and for supplementary treatment of stress and asthma (**Srinivasan, 2005**). Ginger (*Zingiber officinale*), belonging to the Zingiberaceae family, is cultivated in Southeast Asia and has spread extensively worldwide. Numerous investigations have been carried out on ginger extracts' composition and biological activities, such as antimicrobial, antioxidant, and immune-enhancing effects **(Leal *et al.*, 2013).** Ginger is used in various food products as a flavor and condiment, imparting their essence **(Park *et al*., 2008).**

The present study aims to assess the impact of herbal extracts addition, such as ginger and sweet basil, and bees honey as a natural alternative to sugar, on the physicochemical properties and microbial activity of apple jam.

MATERIALS AND METHODS

Materials

Apples (*Malus domestica*) were purchased from the open markets of El Giza city, Egypt. Dried ginger (*Zingiber officinale*) and sweet basil (*Ocimum basilicum*) in fine powder form were obtained from Bab Elsham, a local retail spice market in Giza city, Egypt. Bees honey was purchased from a local retail spice market in Giza city, Egypt. Plate count agar, potato dextrose agar, and nutrient broth were procured from Oxoid, Hampshire, England. 2,2-diphenyl-1-1picryl-hydrazyl (DPPH), Folin-Ciocalteu reagent, and gallic acid were obtained from Sigma-Aldrich Chime, Steinheim, Germany. All chemicals used in this study were of analytical grade.

Preparation of Ginger Aqueous Extract

Ten grams of ginger powder were soaked in 100 ml hot water at 88 °C in a water bath for 6 hours. The mixture was then filtered using Capron silica cloth (150 µ), and the filtrate was stored in dark bottles in the refrigerator at 4°C±1ºC, following the method described by **Al Qulaly *et al.* (2021).**

Preparation of Sweat Basil Aqueous Extract

According to **El-Bialy *et al.* (2016)** leaf of basil were dried at 50°C for 24 h in hot air oven. 10g of basil was ground and infused in 100 ml hot water stirred for 2hours/37ºC and kept overnight in refrigerator at 4°C ± 1°C. Filtration was then done through a four-layer of cheese cloth. The extract was stored in dark bottles at 4°C ± 1°C till used.

Preparation of Apple Jam

The apple jam was prepared according to the procedure outlined by **El-Ghandour *et al.* (2019)**. The process involved washing, peeling, and cutting the fruits into cubes. These fruit cubes were then cooked in a stainless steel container. A mixture of sugar and fruit cubes was prepared in a 45% to 55% ratio. The mixture was gently heated to a temperature of 105ºC until the total soluble solids (TSS) reached 65%. Subsequently, pectin (at a concentration of 5 g/kg of fruit: sugar mixture) and citric acid (at a concentration of 3 g/kg of added sucrose) were added. The resulting jam was adjusted to a pH value of approximately 4.0. It was then hot-filled into clean and dry jars, subjected to pasteurization, and stored at room temperature (25ºC±5ºC).

Preparation of Apple Jam Plus Honey

The fruit cubes were mixed with honey instead of sugar in the ratio 45% to 55%, gently heated at 105 º*C* and when the (TSS) reached 65%**.** Pectin was added (5 g/kg of fruits plus honey) were added with the same percentage of sugar according to **(Martin *et al*., 2016)**, followed by the addition of citric acid (3 g/kg of honey) at the later stage of processing for preventing too much hydrolysis of the sugar. The clean and sterilized dry bottles were filled with hot jam, closed the cap tightly and kept in a cool place and stored at room temperature (25ºC±5ºC).

Preparation of Apple Jam Plus Herbs Extracts

Jam preparation as mentioned in Table 1 was done as described by **(El-Ghandour *et al*., 2019)** with some modifications, ginger and also basil water extracts were added to prepare fruit jams immediately by 1.5% percentages (*W/V)* according to the research recommended by **Singh and Prasad (2020).**

Microbiological Analyses

The Aerobic Plate (AP) count was determined by serial dilutions on plate count agar (PCA) using the pour plate method. Duplicate plates were then incubated at 30 ºC for 48 hours. Similarly, the enumeration of total yeasts and molds (YM) count was conducted using the same dilutions on potato dextrose agar (PDA) at 25 ºC for 5 days, employing the pour plate method. Additionally, the Coliform group (CG) count, using the same dilutions, was carried out on MacConkey agar (MA) at 37ºC for 24 hours. The results were expressed as "cfu (colony-forming units)/ml" in accordance with **APHA (1992)** guidelines.

Chemical Composition Determination

The moisture content, (TSS%), total and reducing sugars, and total acidity were determined following the **AOAC (2012)** methods. The pH values were measured at 25°C using a pH meter (Jenway, 3510, UK). Water activity was assessed using the Lab Start-aw Set (Novasina) AG CH-8853 Lachen, Switzerland, in accordance with the procedure described by **Piga *et al.* (2005)**. Total phenolic compounds were quantified using the Folin-Ciocalteau reagent according to the method described by **Singleton and Rossi (1965)**, while the total flavonoid content was determined using the method outlined by **Jia *et al.* (1999).** The antioxidant activity was evaluated by measuring the ability of the samples to scavenge 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radicals, following the method developed by **Brand-Williams *et al.* (1995).**

Sensory properties determination

The prepared jams were organoleptically evaluated for appearance, texture, color, and taste using a hedonic scale of 9 points, ranging from "not pleasant" to "very pleasant." The evaluation was conducted by 15 judges, including 5 staff members and 10 random consumers according to the method described by **Yassine *et al.* (2015).**

Statistical Analyses

The statistical analyses were performed using one-way variance analysis (ANOVA) with a significance level of 0.05. The analysis was conducted using the statistical program Costas (Ver. 6.400), and the data were treated as a complete randomization design, following the guidelines of **Steel *et al.* (1997).** To determine the significant differences among means of different samples, the LSD test was applied.

Table 1. The different formula of apple jam

ASC	Apple fruit (45%) + sugar (55%) without any addition of extracts.
AGS	Apple fruit (45%) + 1.5% ginger aqueous extract+ sugar (55%).
ABS	Apple fruit (45%) + 1.5% basil aqueous extract. + sugar (55%).
AHC	Apple fruit (45%) + bees honey (55%) without any addition of extracts.
AHG	Apple fruit (45%) + 1.5% ginger aqueous extract +bees honey (55%).
AHB	Apple fruit (45%) + 1.5% basil aqueous extract +bees honey (55%).

RESULTS AND DISCUSSION

Physico-Chemical Analysis

Moisture content (%)

Moisture is a crucial factor that significantly influences products' shelf life and freshness. Food products with high moisture content tend to have shorter shelf lives (**Sutwal *et al.*, 2019**). Results in Fig. 1 and Table 2 demonstrate that the moisture content of all apple jam samples decreased during the storage period for 6 months, which declined from 36.84 to 34.55, 36.87 to 34.61, 36.90 to 34.63, 40.01 to 37.68, 40.04 to 37.70, and 40.07 to 37.71%, respectively for ASC, AGS, ABS, AHC, AGH, and ABH jams. It is worth noting that this decrease in moisture content might be attributed to the evaporation of water from processed product **(Kumar *et al*., 2017)**.

Water activity (%)

Water activity is a critical parameter that provides valuable insights into food's microbial spoilage and physicochemical stability. As indicated in Table 2 and Fig. 2 the water activity of all jam samples decreased over 6 months of storage period at room temperature. Initially, the water activity values were 0.85% for ASC, AGS, and ABS apple jams and 0.82% for AHC, AGH, and ABH apple jams, respectively. Over 6 months, these values gradually decreased to 0.80% for ASC, AGS, and ABS, and 0.79% for AHC, AGH, and ABH, respectively. The decline in water activity during storage can be attributed to moisture loss. Additionally, the decrease in moisture content may be associated with an increase in total soluble solids and total sugars, which bind water and consequently reduce water activity (**Menezes *et al.*, 2011**).

Total soluble solids (ºBrix)

Table 2 and Fig. 3 show that the total soluble solids (TSS) of all apple jam samples increased over 6 months of storage period at room temperature. Throughout the storage period,, the total soluble solids gradually increased from 65 to 68 for ASC, AGS, and ABS, respectively. Meanwhile, the TSS of AHC, AGH, and ABH were increased from 62 to 65. The increase in TSS can be attributed to the reduction in moisture content. These findings are consistent with the findings of **Sutwal *et al.* (2019).**

Total sugar (%)

As recorded in Table 2 and Fig. 4, the total sugar content of all apple jams increased over 6 months of storage period at room temperature. The total sugar content of ASC, AGS, ABS, AHC, AGH, and ABH was increased from 62.48 to 63.37%, 62.50 to 63.42%, 62.51 to 63.47%, 57.72 to 58.25%, 57.30 to 58.20%, and 57.34 to 58.22%, respectively. The conversion of starch and other insoluble carbohydrates into sugars may be responsible for this increase in total sugar content **(Sutwal *et al*., 2019).**

Table 2. Physico-chemical analysis of apple jam at zero time of storage period at room temperature (25ºC±5ºC)

Parameter \ Samples	ASC	AGS	ABS	AHC	AGH	ABH	LSD 0.05%
Moisture %	36.84^{b} ±0.58	36.87^{b} ± 0.26	36.90^{b}± 0.36	40.01^{a} ± 0.02	40.04^{a} ±0.21	40.07^{a} ± 0.34	0.73
Water activity %	0.85^{a} ± 0.00	0.85^{a} ± 0.00	0.85^{a} ± 0.00	0.82^{b} ± 0.00	0.82^{b} ± 0.00	0.82^{b} ± 0.00	0.01
TSS (ºBrix)	65^{a} ± 0.00	65^{a} ± 0.00	65^{a} ± 0.00	62^{b} ± 0.00	62^{b} ± 0.00	62^{b} ± 0.00	0.04
Total sugar %	62.48^{a} ± 0.4	62.50^{a} ± 0.4	62.51^{a} ± 0.2	57.21^{b}± 0.5	57.30^{b} ± 0.3	57.34^{b} ±0.4	0.82
Reducing sugar%	23.93^{b} ± 0.8	23.88^{b} ± 0.7	23.91^{b} ± 0.6	36.36^{a}± 0.5	36.34^{a} ± 0.5	36.31^{a} ±0.5	1.30
Titratable acidity %	0.27^{b} ± 0.00	0.26^{b} ± 0.00	0.25^{b} ± 0.00	0.57^{a} ± 0.00	0.56^{a} ± 0.00	0.57^{a} ±0.02	0.03
pH	3.65^{a} ± 0.00	3.64^{b} ± 0.00	3.63^{b}± 0.00	3.39^{c} ± 0.00	3.37^{e} ± 0.00	3.38^{d}±0.02	0.01

Apple jam with sugar (control) (ASC), apple jam + 1.5% ginger aqueous extract + Sugar **(**AGS), apple jam + 1.5% basil aqueous extract+ Sugar **(**ABS), apple jam with bees honey (control) (AHC), apple jam + 1.5% ginger aqueous extract+ bees honey **(**AGH) and apple jam + 1.5% basil aqueous extract **+**bees honey **(**ABH).

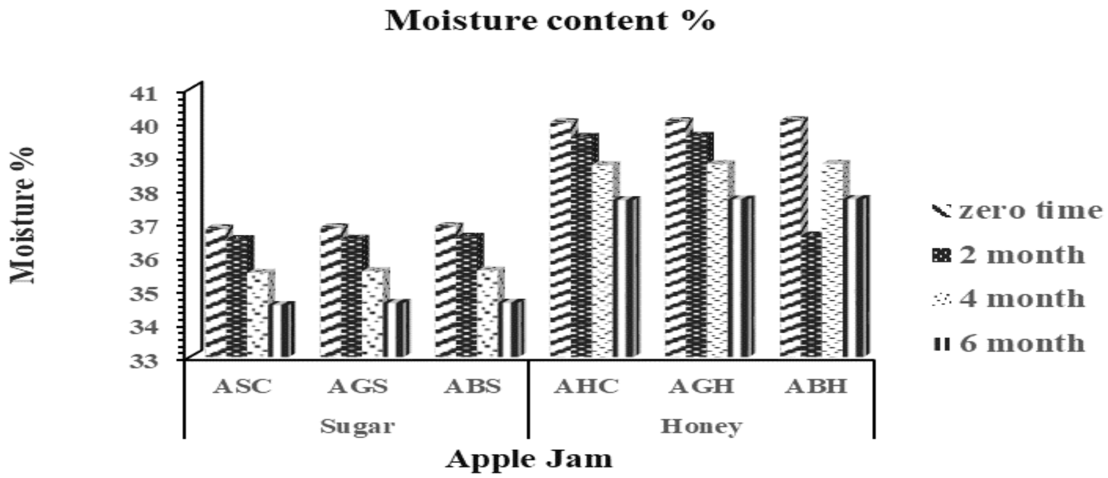

Fig. 1. Effect of storage period on the moisture content of different apple jams

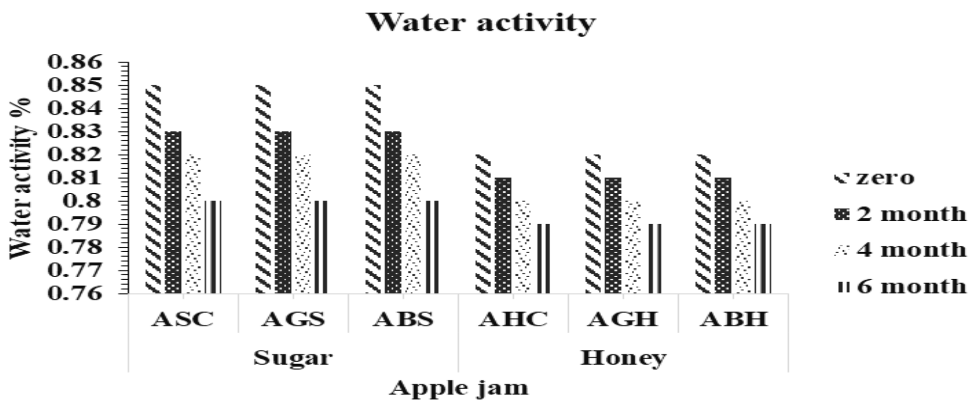

Fig. 2. Effect of storage period on water activity of different apple jams

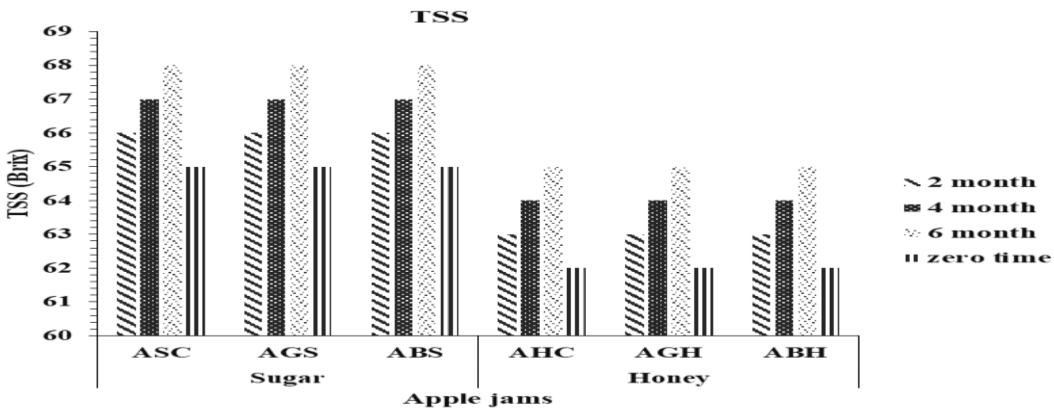

Fig. 3. Effect of storage period on TSS (ºBrix) of different apple jams

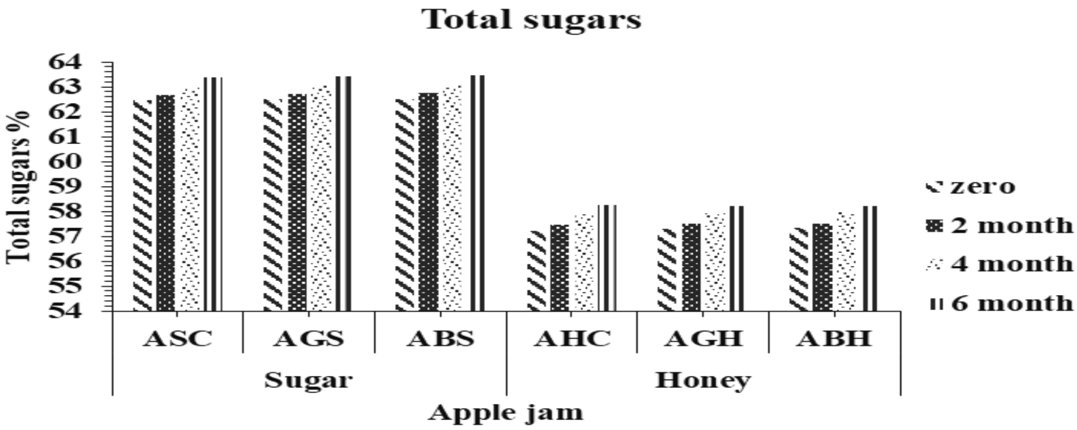

Fig. 4. Effect of storage period on total sugar (%) of different apple jams

Reducing sugar (%)

As shown in Table 1 and Fig. 5, the content of reducing sugars in apple jam increased over a 6 months storage period at room temperature. The reducing sugar content of samples ASC, AGS, ABS, AHC, AGH, and ABH was initially recorded with values of 23.93, 23.88, 23.91, 36.36, 36.34, and 36.31%, respectively, while it gradually increased to 26.78, 26.75, 26.77, 38.20, 38.18 and 38.24%, respectively. The increase in reducing sugar levels can be attributed to sucrose inversion into reducing sugar, specifically glucose and fructose, due to the acidic environment and prolonged storage duration **(Sutwal *et al.*, 2019).**

Titratable acidity (%)

The titratable acidity of the jam samples is shown in Table 2 and Fig. 6. The titratable acidity of the honey apple jams was higher than the sugar apple jams, which could be attributed to the presence of organic acids in honey (**Kapira *et al.*, 2023).** The initial acidity levels of samples ASC, AGS, ABS, AHC, AGH, and ABH were 0.27%, 0.26%, 0.25%, 0.57%, 0.56%, and 0.57%, respectively. These values gradually increased over the 6 months storage period at room temperature to 0.30%, 0.29%, 0.28%, 0.6%, 0.59%, and 0.58%, respectively. This increase in acidity can be attributed to the formation of organic acids due to polysaccharide degradation **(Sutwal *et al.*, 2019).**

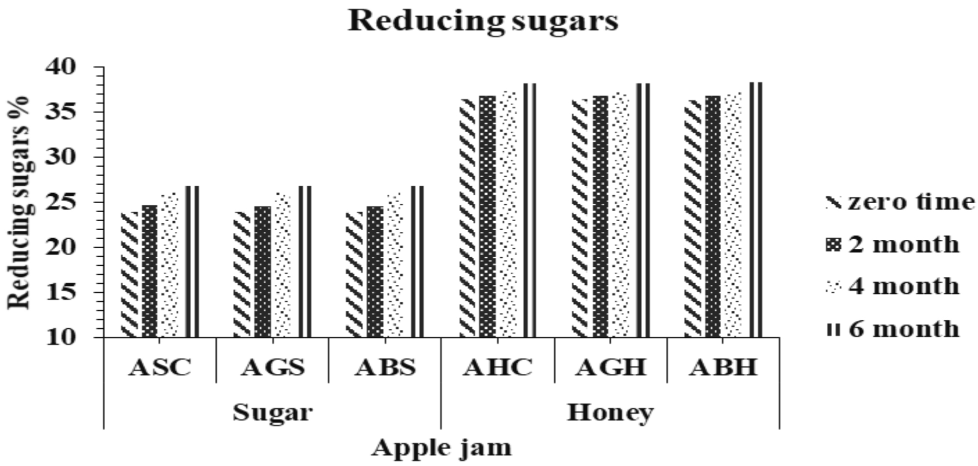

Fig. 5. Effect of storage period on reducing sugar content (%) of different apple jams

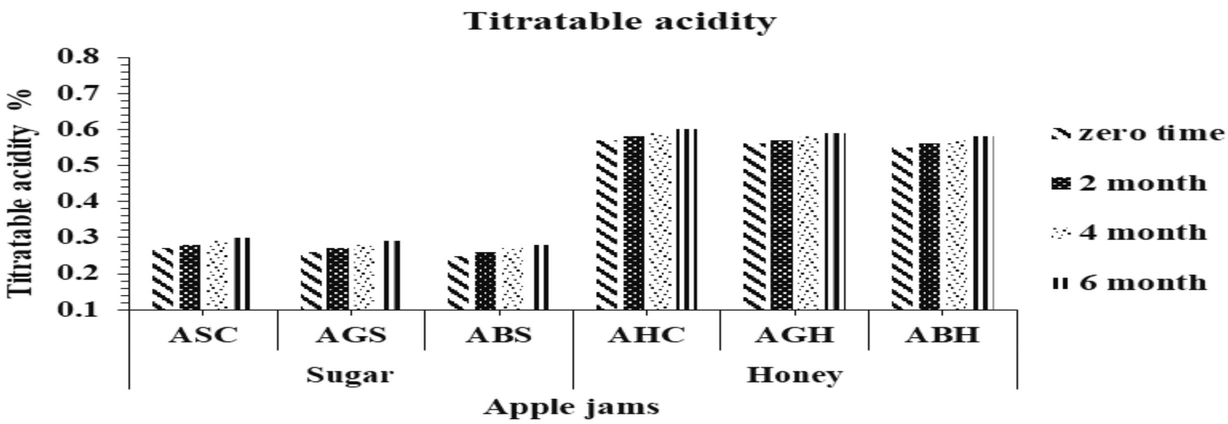

Fig. 6. Effect of storage period on titratable acidity (%) of different apple jams

pH values

The pH level is a crucial parameter influencing the optimal gel condition in jam. As shown in Table 2 and Fig.7, the pH values of all jam samples decreased during the 6 months storage period at room temperature. Initially, pH values were 3.65, 3.64, 3.63, 3.39, 3.37, and 3.38 for ASC, AGS, ABS, AHC, AGH, and ABH, respectively. These values gradually decreased to 3.53, 3.52, 3.51, 3.3, 3.28, and 3.29, respectively over the storage period of 6 months. The slight decrease in pH during storage can be attributed to the slight increase in acidic content resulting from sugar degradation **(Sutwal *et al*., 2019).**

Antioxidant Activity

Table 3 and Fig. 8 illustrates the percentage of DPPH radical inhibition in the studied jam samples over a storage period for 6 months at room temperature. Among the samples, ABH (apple jam with honey and 1.5% basil water extract) exhibited the highest inhibitory percentage, while the control sample (ASC) showed the lowest inhibition. These differences were statistically significant compared to the other treatments ($p < 0.05$).

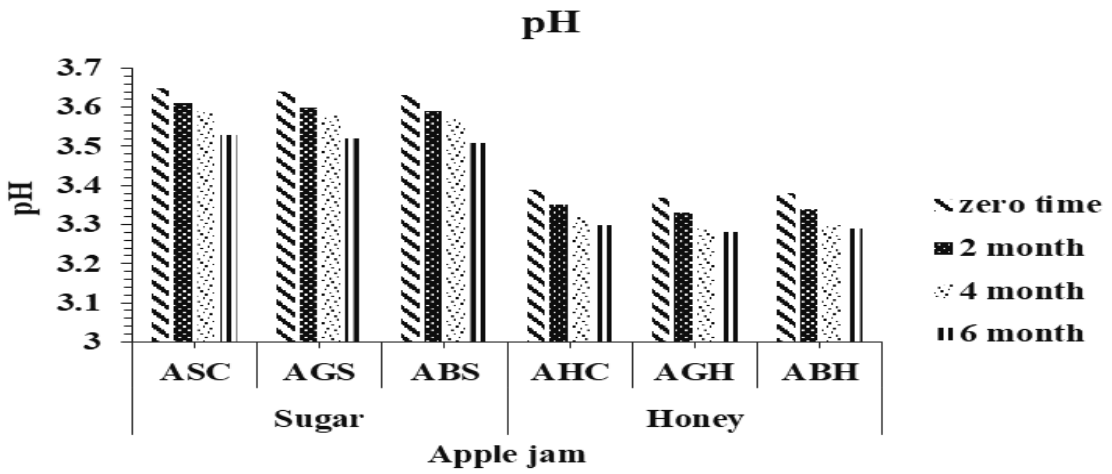

Fig. 7. Effect of storage period on pH value of different apple jams

Table 3. Phytochemical analysis of apple jam at zero time

Samples / Parameter	ASC	AGS	ABS	AHC	AGH	ABH	LSD 0.05%
Antioxidant activity (DPPH) %	22.33^{d} ±0.4	26.07^{c} ±0.6	30.01^{b}± 0.2	25.73^{c} ± 0.2	29.05^{b} ±0.3	23.05^{a} ± 0.4	0.78
Total phenolic compound mg/g	0.43^{e} ±0.01	0.48^{d} ±0.01	0.55^{c} ±0.01	0.57^{c} ±0.02	0.61^{b} ±0.01	0.68^{a} ±0.01	0.03
Total flavonoids compound mg/g	0.18^{d} ±0.01	0.28^{c} ±0.01	0.35^{b}± 0.03	0.31^{c} ±0.01	0.40^{b} ±0.05	0.49^{a}± 0.01	0.05

Apple jam with sugar (control) (ASC), apple jam + 1.5% ginger aqueous extract + Sugar (AGS), apple jam + 1.5% basil aqueous extract+ Sugar (ABS), apple jam with bees honey (control) (AHC), apple jam + 1.5% ginger aqueous extract+bees honey (AGH) and apple jam + 1.5% basil aqueous extract +bees honey (ABH).

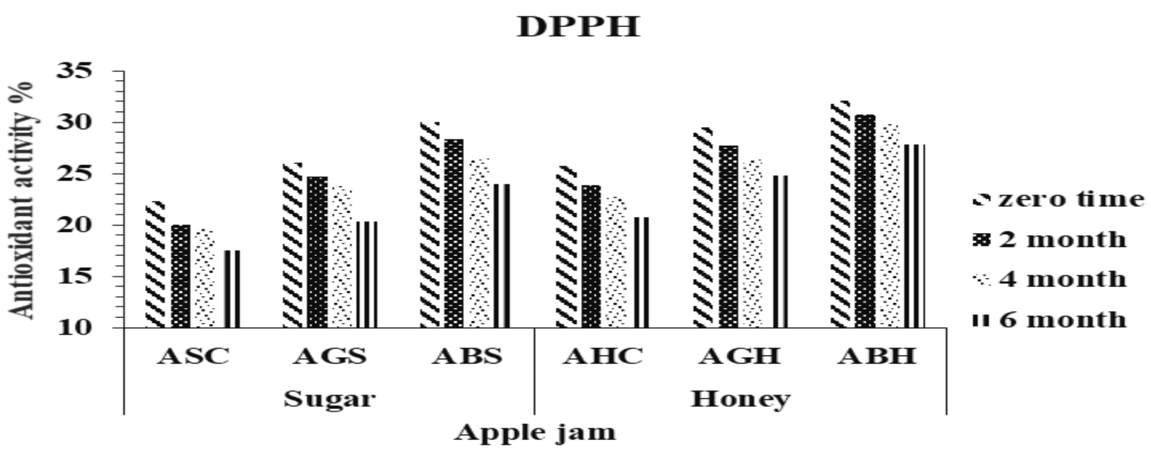

Fig. 8. Effect of storage period on antioxidant activity DPPH (%) of different apple jams Total phenolic compound mg/g

This study suggested that adding herbal extracts and substituting sugar with honey significantly enhanced the inhibition of DPPH radicals, indicating increased antioxidant activity ($p < 0.05$). This effect could be attributed to the presence of specific phytochemical components in the plants, such as phenolic compounds, as well as metabolic by products resulting from bacterial activity **(Mosiyani *et al.*, 2017).**

The results presented in Fig. 8 confirms that the antioxidant activity of all jam samples slightly decreased over a storage period up to 6 months at room temperature. Initially, the antioxidant activity values were 22.33, 26.07, 30.01, 25.73, 29.05, and 32.05 % for ASC, AGS, ABS, AHC, AGH, and ABH, respectively. These values gradually declined to 17.53, 20.28, 23.99, 20.69, 24.82, and 27.78 %, respectively, during storage period. These findings are consistent with the results reported by **Rababah *et al*. (2011)**, who observed a significant decrease ($P < 0.05$) in the antioxidant activity of strawberry jam during storage periods.

Various polyphenolic compounds found in fruits and vegetables have been recognized for their antioxidant activities, attributed to the reactivity of the phenolic moiety, which enables them to scavenge free radicals through hydrogen or electron donation **(Naresh *et al.*, 2015)**. Results in Table 3 and Fig 9 show a significant increase in total phenolic content (TPC) of different apple jams. The highest TPC was observed in ABH (apple jam with 1.5% basil water extract+ honey), while the control sample (ASC) exhibited the lowest TPC. These results indicate that including herbal extracts and substituting sugar with honey led to a significant increase in TPC. This could be attributed to the unique phytochemical components present in the plants (phenolic components) and the metabolic products resulting from bacterial activity (**Mosiyani *et al.*, 2017**).

Based on the results presented in Fig. 9, it can be observed that the total phenolic compounds (TPC) in all jam samples slightly decreased over the 6 months of storage period at room temperature. Initially, the recorded values for total phenolic compounds were 0.43, 0.48, 0.55, 0.57, 0.61, and 0.68 mg/g for ASC, AGS, ABS, AHC, AGH, and ABH, respectively. However, these values gradually declined during the 6-month storage period to 0.33, 0.38, 0.45, 0.44, 0.49, and 0.53 mg/g, respectively. These findings align with the results reported by **Banaś *et al.* (2018),** who found that the average content of total polyphenols in strawberry jam decreased by 16% after 6 months of storage.

Total Flavonoid Compounds (mg/g)

As shown in Table 3 and Fig. 10, it can be found that the total flavonoid compounds in all jam samples slightly decreased over the 6 months of storage period at room temperature. The total flavonoid compound values were gradually declined from 0.18 to 0.14, 0.28 to 0.19, 0.35 to 0.29, 0.31 to 0.22, 0.40 to 0.32, and 0.49 to 0.40 mg, respectively for ASC, AGS, ABS, AHC, AGH, and ABH. This decrease in total flavonoid compounds during storage aligns with the findings of **Rababah *et al.* (2011).**

Microbiological Analyses

According to the results in Table 4, no bacterial counts were detected at initial time (zero time) and during storage period at room temperature for 2, 4, and 6 months. Meanwhile, mold and yeast were not detected at zero time except the control (ASC), where were 5×10^2 and 3×10^3 while it increased reaching to 33×10^2 and 11×10^3 ,respectively after storage periods for 6 months. Similarly, mold and yeast levels in the treatment AGS were 2×10^2 at zero time and increased to 11×10^2 and 4×10^3 C.F.U/g after 6 months of storage period. Although there was a slight increase in yeast and mold counts in jam samples ASC and AGS during storage, it remained within the allowable limit.

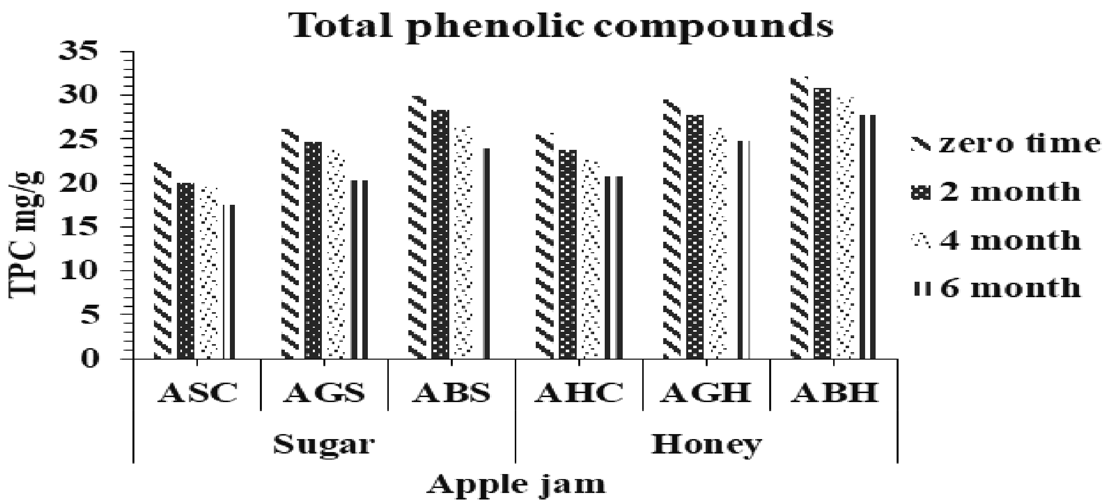

Fig. 9. Effect of storage period on total phenolic compounds (mg/g) of different apple jams

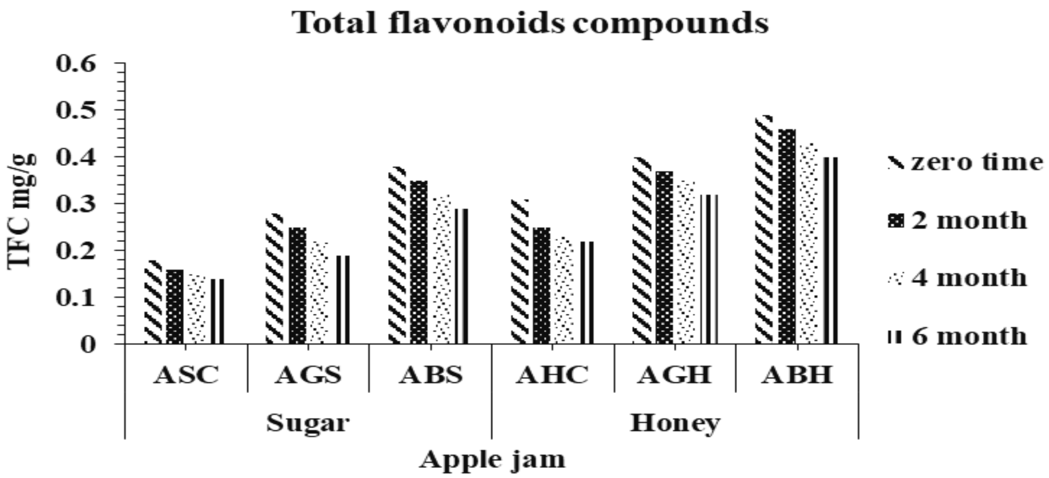

Fig. 10.Effect of storage period on total flavonoids compounds (mg/g) of different apple jams

Sensory Characteristics of Apple Jam

The sensory attributes of apple jam, including taste, color, appearance, texture, and overall palatability, were evaluated over a storage period for 6 months at 25ºC±5ºC. The results presented in Table 5 indicate no significant differences ($p < 0.05$) in the sensory attributes between the control sample and each of the apple jam treated with ginger, basil aqueous extracts, and sugar substitute. The sample AGS (apple jam with 1.5% ginger aqueous extract + sugar) received the highest scores across all sensory evaluation parameters. Furthermore, the results revealed a slight decrease in scores for all treatments after 2, 4, and 6 months of storage. These results align with the **Khan *et al.* (2012)**, who observed decreasing trend in overall acceptability of strawberry jam from during storage.

Table 4. Effect of storage period on total visible counts of apple jam (cfu/g)

Blend	Total bacterial count log cfu/g					Yeast & mold log cfu/g				
	Zero Time	After 2 months	After 4 months	After 6 months	Acceptability range of bacterial count (per plate)	Zero time	After 3 months	After 4 months	After 6 months	Acceptability range of yeast and mold count (per plate)
ASC	ND	ND	ND	ND	30 cfu.-300 cfu	5×10^2 3×10^3	11×10^2 6×10^3	23×10^2 9×10^3	33×10^2 11×10^3	15cfu-120cfu
AGS	ND	ND	ND	ND		2×10^2	5×10^2	8×10^2 2×10^3	11×10^2 4×10^3	
ABS	ND	ND	ND	ND		ND	ND	ND	ND	
AHC	ND	ND	ND	ND		ND	ND	ND	ND	
AGH	ND	ND	ND	ND		ND	ND	ND	ND	
ABH	ND	ND	ND	ND		ND	ND	ND	ND	

Apple jam with sugar (control) (ASC), apple jam + 1.5% ginger aqueous extract + Sugar **(**AGS), apple jam + 1.5% basil aqueous extract+Sugar **(**ABS), apple jam with bees honey (control) (AHC), apple jam + 1.5% ginger aqueous extract+ bees honey **(**AGH) and apple jam + 1.5% basil aqueous extract **+**bees honey **(**ABH).

Table 5. Changes in sensory evaluation of apple jam during storage at 25ºC±5ºC for 6months

Treatment							
Taste (10)							
Month	**ASC**	**AGS**	**ABS**	**AHC**	**AGH**	**ABH**	**LSD 0.05%**
zero	9.37^{ab}±0.4	9.50^{a} ±0.5	8.88^{ab}±0.8	9.28^{ab}±0.6	9.42^{a}±0.6	8.64^{b}±0.6	0.80
2	9.0^{ab} ±0.5	9.12^{ab} ±0.5	8.55^{b}±0.8	9.01^{ab}±0.6	9.28^{a}±0.6	8.5^{b}±0.6	0.74
4	8.75^{ab} ±0.9	9.0^{a} ±1.0	8.22^{b}±0.4	8.71^{ab}±0.4	9.0^{a}±0.7	8.21^{b}±0.5	0.84
6	8.25^{ab} ±0.9	8.5^{ab} ±0.8	8.0^{b}±0.8	8.28^{ab}±1.0	8.71^{a}±1.0	8.07^{b}±0.6	1.04
Color(10)							
Zero	9.50^{a}±0.5	9.57^{a}±0.6	9.28^{a}±0.7	9.71^{a}±0.5	9.57^{a}±0.5	9.28^{a}±0.7	0.72
2	9.25^{a}±0.5	9.43^{a}±0.6	9.0^{a}±0.7	9.50^{a}±0.6	9.36^{a}±0.4	9.14^{a}±0.8	0.75
4	9.0^{a}±0.7	9.29^{a}±0.6	8.83^{a}±0.7	9.29^{a}±0.9	9.17^{a}±0.6	9.07^{a}±0.9	0.95
6	8.8^{a}±0.8	9.21^{a}±0.7	8.67^{a}±0.8	9.21^{a}±1.0	9.0^{a}±0.8	8.93^{a}±0.8	1.05
Appearance(10)							
zero	9.50^{a}±0.5	9.57^{a}±0.6	9.08^{a}±0.7	9.21^{a}±0.6	9.29^{a}±0.7	9.57^{a}±0.5	0.76
2	9.31^{a}±0.6	9.36^{a}±1.0	8.83^{a}±0.6	9.07^{a}±0.6	9.14^{a}±0.6	9.43^{a}±0.5	0.84
4	9.05^{a}±0.9	9.17^{a}±0.7	8.75^{a}±0.7	8.93^{a}±0.4	9.00^{a}±0.5	9.29^{a}±0.5	0.80
6	8.88^{a}±0.9	8.93^{a}±0.7	8.58^{a}±0.4	8.79^{a}±0.5	8.86^{a}±0.3	9.14^{a}±0.6	0.81
Texture(10)							
Zero	9.38^{a}±0.6	9.43^{a}±0.7	9.29^{a}±0.6	9.07^{a}±0.8	9.0^{a}±0.8	9.29^{a}±0.7	0.81
2	9.13^{a}±0.7	9.21^{a}±0.6	9.07^{a}±0.5	8.93^{a}±0.7	8.80^{a}±0.7	9.13^{a}±0.5	0.73
4	9.00^{a}±0.7	9.14^{a}±0.6	8.93^{a}±0.6	8.86^{a}±0.6	8.70^{a}±0.7	9.00^{a}±0.5	0.69
6	8.69^{a}±0.9	8.97^{a}±0.6	8.57^{a}±0.3	8.71^{a}±0.9	8.60^{a}±0.9	8.79^{a}±0.4	0.70
Overall palatability (40)							
Zero	37.74^{b}±0.6	38.06^{a}±0.7	36.53^{e}±0.6	37.27^{c}±0.8	37.27^{c}±0.8	36.98^{d}±0.7	1.77
2	37.69^{b}±0.5	37.12^{a}±0.6	35.46^{e}±0.6	36.5^{c}±0.6	36.57^{c}±0.6	36.20^{d}±0.5	1.76
4	35.8^{b}±0.8	36.6^{a}±0.6	34.73^{e}±0.6	35.78^{c}±0.6	35.88^{c}±0.6	35.57^{d}±0.5	1.75
6	34.56^{b}±0.9	35.42^{a}±0.7	33.82^{e}±0.5	35.0^{c}±0.8	35.14^{c}±0.7	34.92^{d}±0.6	1.76

Apple jam with sugar (control) (ASC), apple jam + 1.5% ginger aqueous extract + Sugar **(**AGS), apple jam + 1.5% basil aqueous extract+ Sugar **(**ABS), apple jam with bees honey (control) (AHC), apple jam + 1.5% ginger aqueous extract+ bees honey **(**AGH) and apple jam + 1.5% basil aqueous extract **+bees** honey **(**ABH).

Conclusion

The addition of herbal extracts, sweet basil (*Ocimum basilicum*), and ginger (*Zingiber officinale*), with concentration of 1.5 %, as well as the substituting of sugar with bees honey to apple jam, can raise nutritional value and extend the shelf life due to the its antioxidant and antimicrobial properties.

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الملخص العربي

تقييـــم جـــــودة منتجـــــات مربـى التفـــاح الصحية المدعمـــة بمستخلصات الأعشـــاب الطبيعية

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يعتبر عسل النحل غذاءً صحياً له فوائد عديدة لصحة الإنسان وتغذيته وكذلك استخدام الأعشاب كعوامل منكهة ومواد حافظة طبيعية بسبب نشاطها المضاد للميكروبات ضد بعض مسببات الأمراض وخصائصها المضادة للأكسدة. تهدف هذة الدراسة الى تقييم تأثير المستخلصات المائية لكل من الريحان والزنجبيل وايضا استبدال السكر بعسل النجل كمحلى طبيعي،على الخصائص الفيزيائية والكيميائية والميكروبية والحسية لمربى التفاح خلال فترة تخزين مدتها 6 أشهر على درجة حرارة الغرفة25 درجة مؤية. اظهرت النتائج أن الاستبدال الكلي للسكر بعسل النحل وكذلك اضافة المستخلص المائى للريحان بنسبة 1.5% لمربي التفاح رفع قيمة مضادات الأكسدة والفينولات والفلافونويدات مقارنة بالكنترول. كما اظهرت نتائج التقييم الحسي أن استبدال السكر بعسل النحل في مربي التفاح أدى إلى تحسين الخواص الحسية مقارنة بالكنترول. بالإضافة إلى ذلك فإن إضافة المستخلصات المائية للريحان والزنجبيل مع استبدال السكر بالعسل كان له الأثر الأكبر في تقليل العد الكلي البكتيري لعينات مربى التفاح خلال فترة التخزين6 اشهر. وبصورة عامة فإن هذا البحث يوصي باستخدام مستخلصات الريحان والزنجبيل المائية، إلى جانب استبدال السكر بعسل النحل لرفع القيمه الغذائية والصحية لمربي التفاح وكذلك إطالة فترة الصلاحية.

الكلمات الاسترشادية: مربى التفاح، المستخلص المائي للزنجبيل، المستخلص المائي للريحان، العسل، الأغذية الوظيفية.

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