

Housewives' Knowledges and Practices of Utilizing Prickly Pear Peels and Its Use in Fortifying Some Bakery Products (Cake & Biscuits): An Applied Study

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ABSTRACT

This study aimed to identifying the housewives' knowledge and practices on prickly pear peels, their benefits, recycling and reusing in the fortification of some bakery products e.g. cakes and biscuits. Two studies were conducted; the first is a qualitative study by a questionnaire on a sample of 100 housewives to investigate the participants' knowledge and practices on the uses of prickly pears peels (PPP). The second study is a laboratory (applied) study includes preparing and testing the cakes and biscuits fortified with 5,10 and 15% PPP. The results revealed a low level of knowledge and practices on PPP among the participants. There was a significant correlation between the level of knowledge and practices of participants regarding PPP and some socio-economic variables. A statistical significant difference in both knowledge and practices was found between the participants according to their age group in favor of those who are over 45 years old. A statistical significant differences in knowledge and practices in favor of participants with university degrees and high monthly income of more than 4000 pounds, as well as in favor of those who live in urban areas and who are workers. On the other hand ,chemical compastion results revealed that the PPP contain moisture, protein, fats, ash, carbohydrates, dietary fiber and calories at rates with 7.50, 4.45, 3.54, 8.20, 76.31, 35.88, (g/100g) and 354.90 (Kcal / 100g), respectively. The results also showed that the PPP is rich in total phenols, carotenoids and antioxidant activity. An improvement in the nutritional value of the products prepared from PPP was noticed. The study recommended the necessity of increasing the knowledge and practices of housewives on the use of PPP by all available means.

Key words: Prickly pear peel - knowledge - practice - chemical composition - antioxidant activity

Introduction

Women are the primary responsible persons for home education and bringing up whether in the urban or the rural areas, where all family members are affected by them along with their crucial role in maintaining the health and safety of the environment, whether their domestic environment or their surrounding external environment (**Kandil *et al.*, 2003**). In addition, housewives are responsible for the health and safety of food and its protection from various pollutants found in the environment (**Bendary, 2006**). Therefore, it is necessary to increase the awareness of housewives regarding their environment in order to avoid the damages which cause environmental pollution and deterioration as a result of the human intervention so that this would be reflected in their practice according to the desired environmental behavior (**Bendary, 2006**).

Due to the use of the fruit, a large amount of waste is produced such as seeds, kernels and peels. This waste is produced by families and during food processing. Accordingly, it was found that there is a big problem in disposing of this waste because it can cause many health problems for humans. Therefore, researchers tend to use this waste as by-products as additives or supplements to make use of them (**Vasso and Constantina, 2007**). Fruit waste contains many important nutrients, such as antioxidants and fibers, which have important biological activity. For instance, the dietary fibers prevent degenerative diseases, high blood pressure, diabetes, and obesity as well as carotenoids and phenols which protect humans from cardiovascular diseases and cancer and reduce the incidence of being inflicted by various diseases (**Oroian and Escriche, 2015**).

Therefore, researches have recently resorted to use fruits and vegetables waste as economic sources for the important biological compounds, and to make use of this waste in many food, pharmaceutical and cosmetic industries, and as one of the ingredients of bakery. Actually, the bakery industry in Egypt has grown significantly in the recent years as bakery products are diversified by adding various ingredients characterized with high nutritional value. Among the added ingredients, the dietary fibers and phytochemicals which have received overwhelming attention. Several studies have reported improvement in the nutritional and functional properties of cookies and bread by combining flour with powdered by-products of some plants (**Ahmed, 2016**).

Prickly pear (***Opuntiaeficus-indica***) (PP) belongs to the *Cactaceae* family. It is found in large quantities in South Africa, Latin America and the Mediterranean Sea region, including Egypt (**Hassan, 2011**). PP trees are grown

in sandy areas because they are characterized by their lack of water. The pulp of the fruit is very soft and contains hard seeds. Those seeds are highly variable in shape, structure, size and color. Such seeds are usually discarded but they are sometimes eaten as part of the fresh fruit (**Feugang *et al.*, 2006**). PP fruits are sold in the market, peeled or unpeeled, in various attractive colors, such as; white-orange, green, purple, red and yellow. The difference in color is due to the content of the fruit from the betanin pigment, which is used as a natural food colorant (**Stintzing and Carle, 2005**).

PP is one of the fruits which is widely consumed because it has a distinct flavor and is usually consumed fresh or in the manufacture of various food products such as candy, barbecue sauces, alcoholic beverages, jelly, juices, natural liquid sweeteners and jams (**Saenz and Sepulveda, 2001**).

Phenolic compounds are among the most important biological compounds in PP fruit (**Kuti, 2004**), ascorbic acid, betaxanthin and betacyanin pigments, all of which have powerful antioxidant properties (**Gentile *et al.*, 2004**). Prickly pear fruits are rich in dihydroflavonols, flavonols, glycosilated flavonols and flavonones (**Kuti, 2000**). The prickly pear fruits are also high in carbohydrates, vitamins, pigments, pectin and gum (**Stintzing and Carle, 2005**).

When studying prickly pear peels (PPP) as a source of bioactive compounds for nutrition, health and disease, **Arabshahi- Delouee, and Urooj (2007)** found that they contain protein by (8.3%), sugars (25%), minerals (12.13%), cellulose (29%)), Hemocellulose (8.5%) and pectin (3%) on a dry weight basis. Likewise, both **Stintzing and Scheiber (2003)** also indicated that PPP are rich in vitamins, minerals, sugars and amino acids. In addition, **Moussa-Ayoub *et al.* (2011)** indicated that the peels are rich in flavonoids. All these antioxidant compounds make PP fruits an important functional food for the human health to protect them from many diseases such as hypercholesterolemia, cancer, atherosclerosis, diabetes and stomach diseases (**Abou-Ellella and Ali, 2014**).

Despite the multiple benefits of PPP, there is still a lack of awareness of the possibility of utilizing such residues and gaining the benefits from their important nutrients. Hence, the problem lies in the lack of awareness and practices among housewives of the extent to which they can get the benefit from PPP in fortifying food to reduce and prevent many diseases. Hence, there was a need to conduct this study to uncover their knowledge and practices of utilizing PPP and its use in fortifying some bakery products (cake & biscuits).

Materials and Methods

Research methods

The study utilized the analytic descriptive research method as well as the experimental one. The analytic descriptive research method was used to describe the variables of the study, collect information and observations related to the housewives' knowledge about the benefits of prickly pears as well as the extent of their actual practices in using of prickly pears and their peels. This research method was also adopted for analyzing the degree of knowledge and awareness in light of some social and economic variables among housewives (age, educational level, monthly income, place of residence & employment status). As for the experimental research method, it was adopted to study the nutritional value of PPP and bakery products prepared utilizing them.

Study sample:

This study was administered in Alexandria governorate, Egypt. Participants were from the downtown of Alexandria (N=78) and from its rural areas in the Tenth Abees (N=62). The data were collected at housewives' workplaces or at their homes after providing a thorough explanation of the study purpose.

Participants were divided into two sections:

- a) The pilot study participants (N=30) who were randomly chosen to apply the pre-test of the research tools (questionnaire) for conducting the validity and reliability of the study tool.
- b) The main study participants (N=140). Some participants were excluded from the main study participants (30 among the rural areas residents and 10 from the urban areas ones) as they did not respond to the questionnaire properly (Put more than one response in front of the phrase). As such, the main study participants became 100 housewives aging from less than 30 years, from 30 to 45 years, and more than 45 years. They also ranged in their economic and social levels as well as in their work status. They were randomly assigned for responding to the questionnaire of the study.
- c)

The study questionnaire was conducted from mid-October 2019 until the beginning of January 2020. The application period was 2.5 months.

Study tools

A questionnaire was prepared consisting of 3 axes:

The first axis: the housewives' demographic information including (age, educational level, monthly income, place of residence and work status).

The second axis: The housewives' knowledge about the prickly pears. It included general questions about the prickly pears, their peels, and their nutritional and health importance. It consisted 16 questions and their scores were categorized into three levels: High, Medium, and Low: Level 3 for those who scored 38-48 scores, Level 2 for those who scored 27-37 scores, and Level 1 for those who scored less than 26 scores.

The third axis: The housewives' practices regarding the prickly pears. It included general questions about the housewives' use of prickly pears and their peels as well as their nutritional and health importance. It consists of 18 questions and their scores were categorized into three levels: High, Medium, and Low: Level 3 for those who scored 49-54 scores, Level 2 for those who scored 31-48 scores, and Level 1 for those who scored less than 30 scores.

Validity and Reliability of the Study Instruments

The initial form of the questionnaires was designed and subjected to the following procedures for validity and reliability measurements:

1. Content Validity

For assessing the content validity of the questionnaires, they were submitted to a jury (N=6) among professors of Home Economics at the Faculties of Specific Education (Alexandria), Home Economics (Helwan), and Agriculture (Alexandria). They were asked to give their opinions about the content of the questionnaire items regarding their appropriateness to the study purpose. They suggested paraphrasing some items and reorder some others. All their comments and opinions were considered in the final form of the questionnaires.

Table (1): Coefficient of validity of the knowledge and practice questionnaire of PPP:

Questionnaire	r
First: the knowledge of the housewife about the prickly pear	0.499*
Second : the practices of the housewife in the handling and use of prickly pears	0.286*

*: statistically significant at $P \leq 0.01$.

Table (1) shows the values of the Pearson correlation coefficient to calculate the validity of each of the knowledge and practices, which are (0.499-0.286, respectively), which are significant at the level of (0.01). It is noticed that, the questionnaire has acceptable validity coefficient which indicates the possibility of its use in the current study.

2-Reliability of the Questionnaires

To assess the reliability of the questionnaires, the pilot sample scores on the questionnaire (N=30) were coded in SPSS. Cronbach's alpha was calculated and yielded 0.927 for the questionnaire of the housewives' knowledge about the prickly pears and 0.919 for the questionnaire of the housewives' practices regarding the prickly pears. These values indicate that the questionnaires are of high reliability and can be used over time to assess housewives' knowledge and practices regarding the prickly pears.

Table (2): Coefficient of reliability of the knowledge and practice questionnaire of Prickly Pear peels

Questionnaire axes	Cronbach's Alpha
First: the knowledge of the house wife about the PPP	0.927
Second: the practices of the house wife in the handling and use of PPP	0.919

PPP: prickly pear peels

The applied study

The study was applied on bakery products "cake & biscuits" fortified with PPP powder.

Materials and Methods:

The good fruits of prickly pears and the other raw materials used in preparing the products were purchased from the local market.

The fresh and good ripe prickly pear fruits were collected. Then, the fruits were washed using tap water several times. Then, are soaked in sodium chloride solution (1%) for 5 minutes. The fruits were then washed with ethanol (70%). Then, they are washed twice with distilled water for removing any attached microbes and dust from the surface of the fruits. The outer peels were separated from the fruits using a sharp knife. Then, the peels were cut into small pieces and dried in a thermal oven (AFOS Mini Smoker, England) at the temperature of 40 °c for a period of 48 hours. Then, the dried peels were ground using a mill (Retsch Micro Universal Bench Top Grinder, Germany) and then sifted using a

60 mesh sieve to obtain a fine powder. Then, this powder is kept in a dry, airtight glass jar at the closed freezer at a temperature of -20 until use (Elhassaneen *et al.*, 2016).

Preparation of food products from dried prickly pear peels:

The baking products (cake and biscuits) were fortified with different percentages of PPP (5,10,15%). Baking products were prepared and methods of preparation and cooking were used for the control samples with the necessary adjustments made for the experimental samples such as cake according to the method of Saba (2005), and biscuits according to the method of Mouminah (2015). The percentages and ingredients were summarized in the table (3 and 4).

Table (3) The ingredients used in preparing biscuits per 100g

Ingredients (g)	Control sample (g)	Experimental samples%		
		5%	10%	15%
Wheat flour	100	95	90	85
PPP powder	0	5	10	15
Powder sugar	30	30	30	30
Egg	25	25	25	25
Butter	62.5	62.5	62.5	62.5
Vanilla essence	1	1	1	1
Baking powder	2.5	2.5	2.5	2.5

Table (4): The ingredients used in preparing the cake per 150 grams

Ingredients (g)	Control sample (g)	Experimental samples%		
		5%	10%	15%
Wheat flour	150	142.5	135	127.5
PPP powder	0	7.5	15	22.5
Powder sugar	190	190	190	190
Egg	125	125	125	125
Milk	120	120	120	120
Butter	125	125	125	125
Vanilla essence	5	5	5	5
Baking powder	8	8	8	8

PPP: prickly pear peels

Organoleptic evaluation of the prepared products:

The Organoleptic evaluation of the prepared products was performed by their presentation to a number of arbitrators (n=25) and using the evaluation list

according to (Aljdely and Hemida (2002)). Then, the chemical analyses were performed for the samples which received the highest percentage of general acceptance by the arbitrators and it was 5% for biscuits and 10% for cakes.

Chemical composition of the prickly pear peels and their products:

The chemical composition (moisture, ash, fat, fiber, carbohydrates and minerals) of the PPP powder was assessed on the basis of the dry weight according to the methods mentioned in (AOAC, 2000). The carbohydrates were calculated by difference and the energy was calculated mathematically (Zambrano *et al.*, 2004). As for fat, it was assessed by (Folchet *et al.*, 1957). Then, the raw protein was measured by the method of (Kjeldahl technique AOAC, 2007).

Mineral determination of prickly pear peels and their products:

The following minerals (Magnesium, Calcium, Iron, Zinc) were assessed by using Perkin Elmer Atomic Absorption Spectrophotometer (Model 2380) according to the aforementioned method (AOAC, 2007). Meanwhile, sodium and potassium elements were assessed according to Flame Photometer Model PEP7 as mentioned by the method of AOAC (2000).

Antioxidant activity of prickly pears peels and their products:

Assessment of the total phenolic substances was done according to the method of Folin-Ciocalteu Elfalleh *et al.* (2009). Carotenoids were also assessed according to Choi *et al.* (2002) and the antioxidant activity DPPH was also assessed according to Brand-Williams *et al.* (1995).

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) (Kirkpatrick and Feeney, 2013). Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation. Significance of the obtained results was judged at the 5% level. The used tests were Pearson coefficient, Cronbach's Alpha, Student t-test, F-test (ANOVA), and Post Hoc test (LSD), Spearman coefficient, The relative weight and rating of each individual assessment and Regression.

Results and Discussion

Frist: Qualitative Study

Description of the Main Study Participants

The following is a comprehensive description of the characteristics of the basic study participants as shown in the following table:

Table (5): Relative distribution of the study participants according to some socio-economic characteristics (N = 100)

Variables	Category	%
Age	Less than 30 years old	33
	From 30 to 45 years old	54
	More than 45 years old	13
Educational Level	Literate (She reads and writes)	21
	Intermediate Education	34
	Higher Education	45
Monthly income	Less than 2000 LE	20
	2000-4000 LE	60
	More than 4000 LE	20
Place of Residence	Rural Areas	38
	Urban Areas	62
Work Status	Not Working	57
	Working	43

The table (5) shows that more than half of the sample (54%) aged 30-45 years, and about a third of the sample 33% were less than 30 years old. These age groups are characterized by an increased ability to accept more knowledge and experiences that contribute to increasing their level of public awareness. This indicates that age is one of the factors affecting the awareness level among individuals. As such, it can be expected that the older the participants are, the more public awareness they will have for the increased experiences that enrich people's awareness through getting more knowledge and skills (**Ziadat, 2009**). It was also found that 45% of the study participants had received higher education, whereas more than a third of the sample had intermediate education (34%), which makes it difficult for them to adopt new ideas and methods due to their narrow-mindedness. **Rakesh (2014)** highlighted that education develops rationality and guidance in the behavior of individuals, in general, and their consumer behavior, in particular, as it raises their awareness and knowledge and pushes them to logical thinking.

It also appears that 60% of the study participants had a monthly income of 2000-4000 LE, and 20% only with 4000 LE or more, and less than 2000 LE. Income, also, is one of the most important resources that are responsible for shaping

the general framework of the family life and its members' use of their different resources. **Visvanathan and Trankler (2003)** noted that the higher standard of living of the family and the average per capita income increase the amount of household waste resulting from the misuse of the family various resources.

Regarding the place of residence, the largest percentage of the study participants was from urban areas (62%), while 38% lived in the rural ones. The table also showed that 57% of the study sample do not work compared to 43% who are employed. There is no doubt that women work provides them with many experiences for all life areas.

Information Sources

As knowledge is the basis of behavior and it determines the behaviors and actions of an individual, it was necessary to examine the sources of information that may affect the cognitive and behavioral level of housewives in the study. The results in Table (6) showed that there are five sources of information used by the study participants to get information about the PPP. Internet was the most frequent source of information (67%), followed by media (52%), family (11%), friends and neighbours (10%), then awareness seminars (6%), respectively.

These results show the weak role of counselling and training programs in this area, which directly affect the modification of the behavior and awareness of people. As such, more efforts are required for these programs as emphasized by **Lakshmi et al. (2009)**.

Osman (2016) found that the favorite source of information among half of the study sample regarding household waste disposal is TV programs, as television deals directly with human senses such as sight, perception and hearing altogether. Personal sources such as relatives and neighbors came second to media.

Table (6): Distribution of the study participants according to their sources of information (N=100)

Source of information*	Fr.	%
Internet	67	67.0
Media	52	52.0
Family	11	11.0
Friends and neighbours	10	10.0
Awareness seminars	6	6.0

* Frequencies are greater than the sample size who have information due to the multiplicity of sources of information for some of them.

Housewives' knowledge level about prickly pears and their peels

The table (7) revealed that most of the study participants (76%) have a low level of awareness, and only 14% and 10%, respectively, have medium to high levels of awareness. For more insights about these results, the following table shows the participants' responses to the questionnaire items.

Table (7): Distribution of the study participants according to their knowledge level about the benefits of the prickly pears and their peels

Levels of knowledge	%
Level 1: Low (16-26)	76.0
Level 2: Medium (27-37)	14.0
Level 3: High (38-48)	10.0
Total	100

The data obtained from the study sample about their knowledge of the benefits of prickly pears and their peels revealed that many of them are at the low level of knowledge as shown in Table (8). Few of them are at the high level and the rest are at the medium level of knowledge. The relative weights ranged between 97% to 43.3%.

The results showed that the majority of the sample (67, 65, 74, 65, 64, 64, 67%, respectively) had no information about the following statements No.4, 6, 8, 10, 12, 14 and 16. The relative weight for these statements were 52.3, 48, 43.3, 46, 46.7, 46.3 and 46%, respectively. However, the results indicated that 94% and 90%, respectively, know that prickly pears are summer fruits and that eating prickly pears whenever available is preferred. The relative weight for these statements were 97.0 and 95.3% respectively.

In addition, it was found that 44, 51, 71, 72, 80, 72, 81% of the participants, respectively, had medium level of knowledge about the following statements No. 3, 5, 7, 9,11, 13 and 15. The relative weights for these statements were 64, 66.3, 61, 60.7, 62.7, 58.7, 62.3%, respectively.

Table (8): Frequencies, percentages, and relative weight of housewives' knowledge about prickly pears and their peels (N=100)

No.	Items	Yes	I don't know	No	Means	Relative Weight	Level	Order
		%	%	%		%		
1	PP are summer fruits.	94.0	3.0	3.0	2.91	97.0	High	1
2	Eating PP whenever available is preferred.	90.0	6.0	4.0	2.86	95.3	High	2
3	Eating PP as fruits has a high nutritional value.	24.0	44.0	32.0	1.92	64.0	Medium	4
4	Eating PP as juice is very healthy.	24.0	9.0	67.0	1.57	52.3	Low	10
5	Preparing some foods using PPP adds nutritional values.	24.0	51.0	25.0	1.99	66.3	Medium	3
6	Drying the PPP make them lose their nutritional value.	9.0	26.0	65.0	1.44	48.0	Low	11
7	The PPP are rich in fibre that are very useful to the human body.	6.0	71.0	23.0	1.83	61.0	Medium	7
8	PP prevent gout.	4.0	22	74.0	1.30	43.3	Low	16
9	The PPP stimulate the body to produce red blood cells.	5.0	72.0	23.0	1.82	60.7	Medium	8
10	The PPP help prevent osteoporosis.	3.0	32.0	65.0	1.38	46.0	Low	14
11	The PPP help reduce constipation.	4.0	80.0	16.0	1.88	62.7	Medium	5
12	The PPP improve the level of blood glucose.	4.0	32.0	64.0	1.40	46.7	Low	12
13	The dried PPP help lower blood cholesterol.	2.0	72.0	26.0	1.76	58.7	Medium	9
14	Eating PP helps protect the body from cancer.	3.0	33.0	64.0	1.39	46.3	Low	13
15	The PPP help reduce the body weight.	3.0	81.0	16.0	1.87	62.3	Medium	6
16	The PPP strengthen the immune system.	5.0	28.0	67.0	1.38	46.0	Low	14

PP: prickly pears**PPP: prickly pears peels**

Therefore, it is clear that most of the study participants had lack of enough knowledge about PP which, in turn, reveal their low level of knowledge about the content of the questionnaire. These results might be attributed to the lack of awareness-raising seminars in this field, as it was highlighted that only 6% of participants rely on awareness seminars as a source of their information about prickly pears (Table 6). In addition, media was a source of information for only 52% of the participants which indicates the lack of information materials presented on media channels about fruit wastes, including PPP, and

how to benefit from them. Although the largest percentage of information sources (67%) was for the Internet, it is clear that this area does not receive attention and research by individuals and therefore knowledge rates are very low. This indicates the importance of dealing with this issue in research, media and on the Internet to raise women awareness by all means available, especially housewives, about the importance of these wastes and its many benefits. This might be critical especially with the absence of the culture of reusing these wastes. As such housewives often do not resort to using these peels again, but rather dispose them, and therefore attention must be paid to this issue.

Bendary (2006) and **Al-Hajjar (2003)** highlighted that the accumulation of household waste, including wastes of fruit and vegetable, results in many health problems as it emits unpleasant odors as well as being a perfect environment for crawling insects, microbes and insects such as flies and mosquitoes, which promotes the spread of many diseases. However, if these wastes were recycled, they can achieve a profit of 580 million pounds in addition to a preventive health profit estimated at a thousand times of the economic one, i.e. citizens' health (**Arnout, 2006**). **Osman (2016)** found an increased overall knowledge level of the respondents regarding the methods of utilizing wastes (56.5%). This result does not go along with what **Bendary (2006)** found, as the latter highlighted that respondents lack knowledge of the methods of utilizing household waste.

Housewives' practices level and their use of prickly pears and their peels

Table (9) shows that most of the participants (70%) had a low level of practice, whereas 26% had an average level, and only 4% had medium level of practice. To elaborate, the responses of the study participants' responses on the questionnaire items related to their practices about prickly pears and their peels are depicted in Table (10).

Table (9): Housewives' practices level and their use of prickly pears and their peels

	No. (n=100)	%
Levels of practices		
Low (18 - 30)	70	70.0
Moderate(31 - 48)	26	26.0
High (49 - 54)	4	4.0
Total	100	100

The results shown revealed that most of the study participants were at the low level of practice, as the relative weights ranged from 98% to 34.7%. They also highlighted that most of the study participants (96, 63, 96, 92, 96, 96, 96, 96, 96, 96, 95.91%, respectively) do not do the practices for the statements No. 5, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17 and 18.

The results also showed that the practice percentages were high (81, 91, 96, and 57% of the study sample, respectively, and their relative weights were 89.7%, 96.7%, 98%, 83%, respectively) for the statements No. 1, 2, 6 and 10. However, the practice rates were medium for participants who peel the prickly pears themselves (30%), and for those who purchase peeled prickly pears from the seller (50%).

Hence, it can be concluded that housewives rarely use PPP due to the lack of awareness of the importance of these waste and how to use it. **Osman (2016)** found that housewives get rid of food waste by throwing or as food for birds and poultry. These results are consistent with the findings of **Baroud and Abu al-Ajin (2012)**, as they observed a low level of healthy practices in household waste recycling. They are also consistent with the study of **Atwa (2013)**, who found that the level of household waste recycling practices among the majority of housewives (95.5%) is low to medium, but after their exposure to raising awareness programs, the total scores of household waste recycling practices increased. However, the larger increase was in the total degree of their awareness of how to recycle household waste. Therefore, the awareness programs play a major role in developing a positive improvement in the degree of awareness and practice of housewives regarding the use and utilization of this waste, especially, of the PPP.

Table (10): Frequencies, percentages, and relative weight of housewives' practices regarding prickly pears and their peels (N=100)

Q	Items	Always %	Someti- mes %	No %	Mean	Relative weight %	Level	Order
1	I am keen on eating prickly pears whenever available.	81.0	7.0	12.0	2.69	89.7	High	3
2	When I buy them PP fruits, I pick ones with yellow peels.	91.0	8.0	1.0	2.90	96.7	High	2
3	I peel the PP fruits by myself.	30.0	20.0	50.0	1.80	60.0	Moderate	6
4	I buy the peeled PP from the seller.	50.0	20.0	30.0	2.20	73.3	Moderate	5
5	I keep PPP in boxes.	4.0	0.0	96.0	1.08	36.0	Low	11
6	I eat PP as fruits.	96.0	2.0	2.0	2.94	98.0	High	1
7	I drink PP as juice.	12.0	5 25.0	63.0	1.49	49.7	Low	7
8	I include PP in many food recipes	4.0	0.0	96.0	1.08	36.0	Low	11
9	I look for new recipes that I can prepare with PP.	4.0	4.0	92.0	1.12	37.3	Low	9
10	I advise my children to eat more PP.	57.0	35.0	8.0	2.49	83.0	High	4
11	I dry the PPP to make use of them later on.	4.0	0.0	96.0	1.08	36.0	Low	11
12	I can use powdered PPP in preparing some foods.	4.0	0.0	96.0	1.08	36.0	Low	11
13	I make jelly from the powder of dried PPP.	4.0	0.0	96.0	1.04	34.7	Low	18
14	I use the PPP powder with flour in preparing bread.	4.0	0.0	96.0	1.08	36.0	Low	11
15	I use the PPP powder with flour in preparing cakes.	4.0	0.0	96.0	1.08	36.0	Low	11
16	I make biscuits from wheat flour and the powder of dried PP.	4.0	0.0	96.0	1.08	36.0	Low	11
17	I use the PPP powder as a drink.	4.0	1.0	95.0	1.09	36.3	Low	10
18	I use PPP powder in some slimming recipes.	4.0	5.0	91.0	1.13	37.7	Low	8

PP: prickly pears

PPP: prickly pears peels

Housewives' knowledge and practices on prickly pears and their peels according to some socio-economic characteristics

Spearman Correlation Coefficients were used to calculate Correlation coefficients among the housewives' knowledge and practices on the prickly pears and their peels according to age , education and monthly income variables as seen in Table (11) .

Table (11) showed that there was a statistically significant positive correlation at (0.01) between the housewives' knowledge and practices of

prickly pears and their peels for age group, educational level and for the knowledge only according to the monthly income whereas there was a positive statistically significant correlation relationship at 0.05 level between their practices according to the monthly income.

These results are in agreement with **Sivakumar and Sugirtharan (2010)**, who found that there is a positive relationship between income levels and the amount of waste at the family level. Whereas they differ with the results of **Atwa (2013)**, as it was found that there were no significant differences among the respondents according to their income regarding the degree of awareness and practice of how to recycle household waste.

The results are also in agreement with the studies that were conducted in different parts of the world by **Secondi et al. (2015)** that younger people produce more amount of waste compared to elderly people. Whereas the results differ with the findings of **Atwa (2013)**, as the results indicated that there were no significant differences between the respondents according to their age regarding the degree of their awareness and their practice of how to recycle household waste.

Table (11): Spearman rank correlation coefficients between variables

Variables	Knowledge	Practices
	r_s	r_s
Age	0.625**	0.371**
Education Level	0.268**	0.270**
Monthly income	0.401**	0.251*

r_s : Spearman coefficient

** : Statistically significant at $p \leq 0.01$

* : Statistically significant at $p \leq 0.05$

Differences between the housewives' knowledge and practices about the prickly pears and their peels according to some socio-economic characteristics

Table (12) shows the statistical differences between the level of knowledge and practice of participants according to some socio-economic variables (age - educational level- monthly income).

Mean scores and F value of the housewives' knowledge (68.560) and practices (25.629) revealed that there was statistically significant difference at 0.01 level according to the age variable in favor of housewives who are older than 45 years old.

Table (12): Calculation of ranking differences (N=100)

Variable	N	Knowledge Mean \pm SD.	Practices Mean \pm SD.
Age			
Less than 30 years old	33	25.12 \pm 2.48 ^a	26.52 \pm 3.71 ^a
From 30 to 45 years old	54	28.00 \pm 4.77 ^b	27.39 \pm 3.65 ^a
More than 45 years old	13	40.69 \pm 4.44 ^c	37.77 \pm 10.57 ^b
F		68.560^{**}	25.629^{**}
P		<0.001[*]	<0.001[*]
LSD		3.200	3.939
Education level			
Literate (Reads and writes)	21	25.95 \pm 0.22 ^a	27.76 \pm 3.36 ^a
Intermediate education	34	28.35 \pm 6.64 ^{ab}	25.06 \pm 2.52 ^a
Higher education	45	30.24 \pm 7.12 ^b	31.33 \pm 7.67 ^b
F		3.549[*]	12.432^{**}
P		<0.001[*]	<0.001[*]
LSD		4.318	3.909
Monthly income			
Less than 2000	20	25.50 \pm 2.24 ^a	27.35 \pm 3.66 ^a
2000 - 4000	60	27.52 \pm 4.50 ^a	27.10 \pm 3.55 ^a
More than 4000	20	35.45 \pm 8.79 ^b	33.60 \pm 10.60 ^b
F		21.096^{**}	10.273^{**}
P		<0.001[*]	<0.001[*]
LSD		3.770	4.018
Place of Residence			
Rural	38	24.89 \pm 2.69 ^a	26.47 \pm 3.17 ^a
Urban	62	31.03 \pm 6.78 ^b	29.66 \pm 7.23 ^b
t		6.358^{**}	3.029^{**}
P		<0.001[*]	0.003[*]
Work Status			
Don't work	57	25.26 \pm 2.25 ^a	26.63 \pm 3.47 ^a
Work	43	33.26 \pm 7.09 ^b	30.86 \pm 8.0 ^b
t		7.129^{**}	3.245^{**}
P		<0.001[*]	0.002[*]

t: Student t-test

F: F for ANOVA test, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test (LSD)**

Means with **Common letters** are not significant (i.e. Means with **Different letters** are significant)

*****: Statistically significant at $p \leq 0.05$ ******: Statistically significant at $p \leq 0.01$

This indicates that differences are in favor of the older housewives which might be attributed to their experiences and knowledge about the prickly pears and their peels - even if this knowledge is weak. These results are consistent with the results of **Eaid (2016)** and **Osman (2016)**, as they found that there was a negative correlation between household waste disposal practices and the age of the respondent. They revealed that the younger the respondent, the greater the percentage of low practices.

Regarding the educational level, it was found that the value of (F) was 3.549 for knowledge, which is statistically significant at the level of 0.05; and $F=12.432$ for practices, $P=0.01$. Moreover, there was a statistically significant difference at 0.05 level for knowledge and at 0.01 for practices between literate participants and those who received higher education, while there was no statistically significant difference between literate participants and those of intermediate education level in both knowledge or practices.

This indicates that differences are in favor of highly educated participants which might be attributed to the fact that the higher the educational level, the more knowledge and practices of housewives regarding the prickly pears and their peels - even if this knowledge is weak. These results are consistent with the results obtained by **Nofal *et al.* (2015)**, **Eaid (2016)** and **Osman (2016)**. They revealed that there was a positive correlation between the housewives' education, the number of information sources, the skills of dealing with waste and their level of knowledge as independent variables and the level of the respondents' practices as a dependent variable.

Moreover, the study of **Schneider (2008)** indicated that families whose members (especially husbands) have a high level of education can have higher income levels, and therefore they are more likely to buy and waste more food. However, some studies have found that key family members who are highly educated can plan well, rationally purchase food and have more pro-environmental behaviors resulting in less potential for over-buying, food waste, and waste utilization.

The results revealed that the value of (F) according to the variable of monthly income (21.096) for knowledge and (10.273) for practices, which are statistically significant at 0.01 level for their knowledge and practices. The data revealed that there was a statistically significant difference between participants of monthly income less than 2000 LE and those of more than 4000 LE in favor of those of high income, whereas there was no statistically significant difference between participants of monthly income less than 2000 LE and those of income between 2000- 4000 LE per month in both knowledge and practices.

These results might be due to the fact that the high income helps housewives diversify household foods and thus increases the chance of their knowledge and practice - even if weak - about the benefits of PP and their peels. These results are in agreement with **Mamady (2016)**, who found a relationship between the correct environmental practices of household waste, the knowledge level of the respondents, and the annual household income.

According to the place of residence, as shown in Table (12), the value of (T) was 6.358 for knowledge and 3.029 for practices, which are statistically significant at 0.01 level in favor of participants from urban areas. This may be

due to the fact that urban areas, i.e. cities, increase the opportunity for food diversity prepared at home by housewives, and thus it is reflected in the extent of knowledge and practices - even if weak - among housewives about the benefits of prickly pears and their peels. These results go along with **Eaid (2016)** who found that the mean scores of urban housewives exceeded those of rural women. **Secondi et al. (2015)** also found that there was a significant difference in household food waste between regions or countries due to different culture and habits in food consumption. However, **Nofal et al. (2015)** does not confirm these results as it found that there were no statistically significant differences between urban and rural women in their methods of disposing of household waste.

Concerning work status, it was found that the values of (T) (7.129) for knowledge and (3.245) for practices, were statistically significant at 0.01 level in favor of those who work. This may be due to the fact that work increases the chance of social interaction among housewives and thus it gives a greater opportunity to exchange experiences, consultation, and diversity in the level of foods and the use of the most beneficial ones. This, in turn, is reflected in their knowledge and practice - even if weak - about the benefits of prickly pears and their peels. These results are consistent with **Eaid (2016)**, who found that the mean scores of working housewives were higher than those of non-workers, indicating statistically significant differences workers and non-workers in the level of information and knowledge, as well as practices in favor of working housewives. Moreover, **Nofal et al. (2015)** also noted statistically significant differences in the method of waste disposal between working and non-working housewives.

Regression Model of Housewives' knowledge and practices according to some socio-economic variables

Data in Table (13) revealed that the age variable was the highest influencing variable on the level of knowledge of the housewives at 0.01 level as the value of the regression coefficient and Beta were 11.348 & 1.169, respectively. It was followed by the educational level variable, then the working status variable at 0.01 and the values of the regression coefficient and Beta were 6.362 & 0.785; 3.668 & 0.289, respectively. The monthly income variable came next at 0.01 level and the regression coefficient and Beta 2.620 & 0.263, respectively. Furthermore, residence place was found the least influential variable on the level of knowledge at 0.05 and the regression coefficient and Beta 2.653 & 0.205, respectively. It is expected that some of these socio-

economic variables affect the knowledge level of housewives with a percentage of 72.8%.

Results also revealed that the age variable was the one that prevailed in the participants' practices at 0.01 level with regression coefficient and Beta 6.482 & 0.682, respectively. On the other hand, the rest of the variables were equal in their effect on the participants' practices regarding the use of PPP. The regression coefficient values for each of the educational level, monthly income, place of residence and work status were 1,219, 1.610, 0.434, and 1.001, respectively, whereas Beta values were 0.154, 0.165, 0.034, and 0.080, respectively. It is expected that some of these socio-economic variables affect the level of housewives' practices by 23.5%.

Table (13): Regression model for knowledge and practices

Variable	B	Beta	t	Significant	Rank
Regression model for knowledge					
Age	11.348	1.169	9.275*	0.01	1
Education level	6.362	0.785	8.586*	0.01	2
Income	2.620	0.263	2.822*	0.01	4
Place of Residence	2.653	0.205	2.477*	0.05	5
Working status	3.668	0.289	3.514*	0.01	3
Constant	18.22				
F=50.237*, R²=72.8%					
Regression model for practices					
Age	6.482	0.682	3.227*	0.01	1
Education level	1.219	0.154	1.002	NS	-
Income	1.610	0.165	1.056	NS	-
Place of Residence	0.434	0.034	0.247	NS	-
Working status	1.001	0.080	0.584	NS	-
Constant	22.005				
F=5.780* R² = 23.5%					

B Unstandardized Coefficients

Beta: Standardized Coefficients

t: t-test of significance

F, p: F and p values for the model

R²: Coefficient of determination

*: Statistically significant at $p \leq 0.05$

Second: Results of the applied study:

The organoleptic properties of products prepared from prickly pear peels:

Table (14) shows the results of the organoleptic properties of biscuits prepared from PPP in percentages of 5%, 10%, and 15%. The results showed that there were significant differences ($p \leq 0.05$) in color, taste, smell, texture and general acceptability between control biscuits and biscuits prepared with PPP at 5,

10 and 15%, Where the control was most receptive, followed by 5%, then 10% and finally 15%. Meanwhile, the results showed a small significant differences ($p \leq 0.05$) between the biscuits prepared by adding PPP at the percentages of 10% and 15%. On the other hand, small significant differences were observed in the taste between control biscuits and biscuits prepared by adding PPP in different percentages. This may be due to the nature of the PPP, which do not add any taste nor a distinct flavor. In a similar study conducted by **Elhassaneen *et al.* (2016)** he made a crunchy biscuits by adding PPP at the percentage of 5%. Biscuits was generally accepted by the arbitrators.

Table (14): Organoleptic properties of control biscuits and biscuits prepared from prickly pear peels

Treatments	Color	Taste	Smell	Textures	General acceptance
Control	8.52 ± 0.05 ^a	8.46 ± 0.002 ^a	8.59 ± 0.02 ^a	8.69 ± 0.03 ^a	8.60 ± 0.05 ^a
5%	8.02 ± 0.02 ^b	8.01 ± 0.004 ^b	7.81 ± 0.001 ^b	8.01 ± 0.003 ^b	7.98 ± 0.01 ^b
10%	7.62 ± 0.16 ^c	7.78 ± 0.07 ^c	7.75 ± 0.02 ^c	7.43 ± 0.07 ^c	7.55 ± 0.04 ^c
15%	6.83 ± 0.17 ^d	7.96 ± 0.04 ^b	7.19 ± 0.01 ^d	7.09 ± 0.004 ^d	6.62 ± 0.01 ^d
F	103.97*	192.83*	3221.65*	1136.23*	1760.08*
P	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
LSD	0.2284	0.0679	0.0331	0.0679	0.0648

F: F for ANOVA test, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test (LSD)**

*: Statistically significant at $p \leq 0.05$

Means with **Common letters** are not significant (i.e. Means with **Different letters** are significant)

The organoleptic properties of the cake prepared by adding PPP, were assessed in percentages of 5%, 10% and 15% (Table15). The results indicated that the control cake had a high degree of acceptance in terms of crust color, crumb color, porosity and smell compared to cake by 5%, 10%, 15%, but it was less in general acceptability. The results also showed that the cake prepared by adding peels by 10% was better in taste and general acceptability compared to the rest of the samples. In addition, there were significant differences ($p \leq 0.05$) between the cake samples in both the color of crust and the color of the crumb, and this may be due to the presence of carotene pigment in the PPP, which affects the color. The porosity was affected by the increase in the percentage of PPP, as there was a reverse relationship between them. It was observed that with the increase in the amount of added peels, the arbitrators gave less degree of porosity. The cake prepared with a 10% addition of PPP received the highest assessment of taste and general acceptability, followed by 5%, then 15% and finally the control sample. In light of the results, PPP are considered good sources of natural antioxidants as well as the dietary fibers and thus they can be used in the preparation of many functional foods which are considered highly rich in fibers. The food industry can make benefit of the physical and chemical

properties of fibers to improve the viscosity, texture, organoleptic properties and shelf life of their products. In addition, fiber-rich products can be incorporated into food products as an inexpensive ingredient for partial replacement of flour, fat or sugar, as water and oil retention enhancers and to improve emulsification or oxidation. Nevertheless, the percentage of fibers which can be added to foods is limited, as it can cause unwanted changes in the color, taste and texture of foods (Elleuch *et al.*, 2011).

Table (15): Organoleptic properties of control cake and cake prepared from prickly pear peels

Treatments	Crust color	Crumb color	Porosity	Taste	Smell	General acceptance
Control	8.30±0.002 ^a	8.30±0.04 ^a	7.70±0.05 ^a	6.45±0.01 ^d	8.91±0.06 ^a	6.90±0.14 ^c
5%	5.90±0.02 ^c	6.10±0.02 ^c	7.50±0.01 ^b	8.10±0.03 ^b	8.46±0.02 ^b	7.30±0.02 ^b
10%	7.70±0.02 ^b	7.90±0.03 ^b	6.70±0.08 ^c	8.50±0.04 ^a	7.82±0.15 ^c	7.50±0.01 ^a
15%	4.50±0.03 ^d	4.70±0.05 ^d	5.30±0.08 ^d	7.70±0.05 ^c	6.81±0.16 ^d	4.70±0.03 ^d
F	22985.6*	8146.34*	852.43*	2197.09*	180.93*	1020.51*
P	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
LSD	0.0373	0.0603	0.1218	0.0617	0.2204	0.1317

F: F for ANOVA test, Pairwise comparison bet. each 2 groups was done using **Post Hoc Test (LSD)**

*: Statistically significant at $p \leq 0.05$

Means with **Common letters** are not significant (i.e. Means with **Different letters** are significant)

The chemical composition of prickly pear peels and their products:

It was shown in Table (16) that PPP contain the following; moisture, protein, fats, ash, carbohydrates, dietary fibers and calories at 7.50, 4.45, 3.54, 8.20, 76.31, 35.88 (g/100g) and 354.9 (Kcal / 100g) respectively. These results are consistent with the study conducted by **El-Said *et al.* (2010)** who found that the PPP contain proteins, fibers and ash in proportions of 4.50, 4.88 and 8.00 (g/100g), respectively. These results are also consistent with the study conducted by **Anwar and Sallam (2016)** who reported that the chemical composition of PPP was as follows: moisture 75.8, protein 4.56, fat 3.66, fibers 7.72, ash 8.66 (g/100g). Meanwhile, the study conducted by **El-Kossori *et al.* (2000)** found that the percentage of protein, ash, and fat were as follows: 8.30, 12.13 and 2.43 (g/100g), respectively on a dry weight basis. The results showed that PPP were rich in fibers, which were found at 35.88 (g/100g), and this is consistent with the study conducted by **Habibi *et al.* (2004)** who found that the PPP are rich in dietary fibers at 31.98 (g/100g). Likewise, the study conducted by **Chau and Huang (2003)** found that the dietary fibers in fruits have a higher quality than that in grains because they contain more soluble dietary fibers. In fact, soluble dietary fibers play an important role in human health. Where a diet rich in dietary fibers helps accomplish the following tasks: prevention, reduction and treatment of certain diseases such as; lowering blood pressure,

aiding in weight loss, improving immune function and improving blood lipid concentrations (**Abou-Bakr et al., 2014**).

Table (16) shows the chemical composition of the control cake, as well as the cake prepared by replacing the wheat flour with 10% PPP. The percentage of moisture in the cake ranged from 32.53 to 31.58 (g /100 g), while the percentage of protein ranged from 6.07 to 6.51 (g /100 g). Control cake has a lower ash content (2.75 g/100 g) compared to cake made from PPP (3.57 g/100 g). Meanwhile, the carbohydrate content of the cake varied from 50.28 to 49.62 (g /100 g). The fat percentage ranged from 8.37 to 8.72 (g /100 g) without the presence of any significant differences ($p \leq 0.05$). On the other hand, the results shown at table (18) revealed a clear increase in the total dietary fibers as a result of adding the PPP. The total dietary fibers increased from 10.19 in control cake to 13.78 (g /100 g) for cake prepared with 10% PPP.

The results shown in table (16) showed that the biscuit prepared with the addition of PPP at 5% had a moisture content (5.30 g /100 g) less than that of the control biscuit (6.97 g /100 g). On the other hand, table (18) shows relative similarity values of crude protein, fat and carbohydrates for control biscuits and biscuits prepared by adding PPP. In addition to that, the total dietary fibers content increased significantly ($p \leq 0.05$) from 4.60 (g /100 g) for control biscuits to 6.39 (g /100 g) for PPP biscuits, respectively.

These results are consistent with the results of the study conducted by **Vitali et al. (2009)** who found that the addition of integrated raw materials ingredients and dietary fibers significantly improved the nutritional and functional properties of biscuits. These results are also consistent with the results of the study conducted by **Elleuch et al. (2010)** who found that adding dietary fibers resulted in healthy food products which are low in cholesterol, fats and calories. Nevertheless, fibers can provide many technological properties such as moisturizing properties, oil retention ability, as well as antioxidant capacity. These results are also consistent with the study conducted by **Ahmed (2016)** who indicated that bread made from PPP by 5% showed an increase in the total dietary fiber content, as the percentage in the control sample was 6.98 (g /100 g) and increased to 8.22 (g /100 g). Likewise, **Elhassaneen et al. (2016)** found that when adding PPP by 5% to biscuits, this led to an increase in the dietary fibers content from 5.89 to 8.11 (g /100 g).

These results confirm that such tested by-products can play a significant and crucial role in food / pharmaceutical applications through their high content of bioactive compounds. These results are consistent with the results of the study conducted by **Al-Weshahy and Rao (2012)** who found that the dietary fibers increase intestinal motility and aid in digestion and excretion. Several researchers also reviewed the significance of consuming moderate amounts of dietary fibers for human health. The study conducted by **Jesch and Carr**

(2017) found that insoluble fiber binds to bile acids, which is one of the mechanisms that reduce plasma cholesterol.

Table (16): Chemical composition of prickly pear peels and their products (on dry weight basis)

Measurements (g/100g)	PPP	Cake			Biscuit		t(p)
		Control	Cake / PPP	t(p)	Control	Biscuit / PPP	
Moisture	7.50 ± 0.26	32.53 ± 0.05 ^a	31.58 ± 0.08 ^b	17.882* ($<0.001^*$)	6.97 ± 0.09 ^a	5.30 ± 0.05 ^b	28.702* ($<0.001^*$)
Protein	4.45 ± 0.09	6.07 ± 0.02 ^a	6.51 ± 0.09 ^b	8.703* (0.001*)	7.65 ± 0.60 ^a	7.74 ± 0.43 ^a	0.209 (0.844)
Total fat	3.54 ± 0.66	8.37 ± 0.02 ^a	8.72 ± 0.14 ^b	4.255* (0.013*)	13.03 ± 0.09 ^a	13.2 ± 0.05 ^b	2.897* (0.044*)
Ash	8.20 ± 0.53	2.75 ± 0.02 ^a	3.57 ± 0.09 ^b	14.724* ($<0.001^*$)	0.72 ± 0.01 ^a	1.13 ± 0.03 ^b	19.835* ($<0.001^*$)
Carbohydrates	76.31 ± 0.86	50.28 ± 0.05 ^a	49.62 ± 0.06 ^b	15.017 ($<0.001^*$)	71.63 ± 0.10 ^a	72.63 ± 0.05 ^b	15.624* ($<0.001^*$)
Total dietary fiber	35.88 ± 0.42	10.19 ± 0.04 ^a	13.78 ± 0.04 ^b	116.283* ($<0.001^*$)	4.60 ± 0.08 ^a	6.39 ± 0.08 ^b	27.719* ($<0.001^*$)
Calories (Kcal / 100g)	354.90 ± 0.34	300.73 ± 0.08 ^a	303.0 ± 0.12 ^b	27.214* ($<0.001^*$)	434.4 ± 0.02 ^a	440.3 ± 0.02 ^b	321.985* ($<0.001^*$)

t: Student t-test

PPP: prickly pears peels

Means with **Common letters** are not significant (i.e. Means with **Different letters** are significant)

*: Statistically significant at $p \leq 0.05$. * Carbohydrates (%) calculated as the difference)

Mineral composition:

Minerals content of PPP and its products are illustrated in (table 17) It was evident that, PPP contain a large amount of magnesium, calcium and sodium (977.10, 941.08 and 919.08 mg/100g, respectively), followed by potassium by (315.10 mg/100 g). Meanwhile, the lowest quantities were iron, and zinc. Their values were as follows: 24118. and 90.12 mg/100 g, respectively. Therefore, PPP are a good source of most of the dietary minerals. Accordingly, the mineral content of cake and biscuits increased after adding PPP to them compared to control samples, as shown in table (17).

El-Mannoubi et al. (2009), in their study, noted that prickly pear pulp is an important source of calcium, potassium and magnesium. Nevertheless, they found that the concentration of these minerals in the peel were 13, 6, and 4 times higher than the pulp, respectively. It found that 250 grams of PPP can contribute to 40, 140 and 19 mg of calcium, potassium and magnesium respectively. They are amounts which do not even come close to 10% of the daily requirement (RDA). However, in some food products such as flour, 25 grams of flour supplemented with 25 grams of dried PPP will save 50% of the RDA for potassium and calcium, and 20% and 25% of magnesium in men and women, respectively (**Jiménez-Aguilar et al., 2014**). Therefore, PPP can

significantly contribute to the coverage of the RDA for the aforementioned elements. These results are consistent with the results of the study conducted by (Feugang *et al.*, 2006).

The minerals in plant sources may differ from one place to another, because the mineral content of the soil varies according to the site in which the plant is grown. However, many studies confirmed that the PPP powder is rich in various minerals along with its ability to bind with water and absorb fats (De Wit *et al.*, 2015), and therefore it is suitable in manufacturing many products. This was applied in this study thereof.

Table (17): The mineral composition of prickly pear peels and their products

Measurement Mg / 100g	PPP	Cake		t(p)	Biscuit		t(p)
		Control	Cake / PPP		Control	Biscuit / PPP	
Mg	977.10 ± 0.08	142.69 ± 0.10 ^a	155.61 ± 0.04 ^b	213.457* ($<0.001^*$)	24.02 ± 0.06 ^a	40.19 ± 0.06 ^b	318.217* ($<0.001^*$)
Ca	941.08 ± 0.26	66.97 ± 0.02 ^a	75.48 ± 0.05 ^b	276.342* ($<0.001^*$)	2.93 ± 0.04 ^a	19.12 ± 0.09 ^b	282.435* ($<0.001^*$)
Na	919.08 ± 0.71	40.54 ± 0.08 ^a	43.82 ± 0.00 ^b	71.235* ($<0.001^*$)	32.95 ± 0.08 ^a	37.83 ± 0.01 ^b	106.273* ($<0.001^*$)
K	315.10 ± 0.42	530.31 ± 0.09 ^a	607.71 ± 0.09 ^b	1080.271* ($<0.001^*$)	139.48 ± 0.01 ^a	215.45 ± 0.04 ^b	3329.275* ($<0.001^*$)
Fe	118.24 ± 0.83	4.85 ± 0.03 ^a	4.65 ± 0.04 ^b	6.673* (0.003)	0.95 ± 0.09 ^a	1.73 ± 0.04 ^b	13.511* ($<0.001^*$)
Zn	90.12 ± 0.40	3.50 ± 0.04 ^a	4.42 ± 0.09 ^b	17.106* ($<0.001^*$)	0.27 ± 0.04 ^a	0.55 ± 0.01 ^b	12.587* ($<0.001^*$)

t: Student t-test

PPP: prickly pears peels

Means with **Common letters** are not significant (i.e. Means with **Different letters** are significant)

*: Statistically significant at $p \leq 0.05$

Phytochemical content and antioxidant activity of prickly pear peels and their products:

Table (18) shows the total content of phenols, carotenoids and the antioxidant activity using DPPH% for both PPP and their products. The results showed that PPP are rich in their content of total phenols as well as carotenoids and antioxidant activity. The values appeared as follows: 438.11 (mg of galactic acid. 100 g⁻¹), 215.19 (mg. 100 g⁻¹) and 60.44%, respectively. The results also revealed that when replacing the wheat flour with PPP by 10% in the cake, this led to an increase in the total content of phenols and carotenoids and the antioxidant activity from 22.14, 1.55, 9.60 to 28.50, 4.78 and 13.08, respectively, compared to control cake. Likewise, the levels of total phenols, carotenoids, and antioxidant activity in biscuits prepared by replacing wheat

flour with PPP by 5% increased from 110.11, 3.01, 30.08 to 142.28, 14.25 and 38.10, respectively, compared to control biscuits. The high antioxidant activity of cakes and biscuits made from PPP may be due to their increased content of phenolic compounds and carotenoids.

Several studies showed that PPP are rich in antioxidant compounds. Likewise, the study conducted by **El-Said *et al.* (2010)** found that PPP contain carotenoids by 12.79 mg/100g on a dry weight basis. These results are consistent with the study conducted by **Ahmed (2016)** who indicated that the bread made from PPP by 5% showed an increase in the content of carotenoids, as it increased from 2.56 mg. Grams⁻¹ to 8.90 mg. Grams⁻¹ compared to control bread. The total amount of phenols increased from 1.33 to 103.86 mg (galactic acid). 100g⁻¹). Likewise, several studies conducted by **Hegazy (2009) and Ahmed (2016)** also indicated a positive significant relationship ($p < 0.01$) between total phenols and the antioxidant activity in different plant parts.

In a similar study, both **Ashoush and Gadallah (2011)** studied the effect of mango peels powder, where they substituted wheat flour in different percentages (5%, 10%, 15% and 20%) and assessed the antioxidant properties of biscuits, where they found an increase in the phenols content from 3.84 to 24.37 mg / g in biscuits prepared with different levels of mango peels.

Phenolic compounds accumulate more in the PPP than in the pulp where the total phenolic content in the peels was twice as high as in the pulp (**Yeddes *et al.*, 2013**). The available research on the prickly pear fruits provided a crucial diversity in the total phenolic content. As some researchers reported that prickly pear juice provides an amount of phenols approximately 172 mg/kg (**Chavez-Santoscoy *et al.*, 2009**) and 452 mg/kg of pulp, respectively (**Medina *et al.*, 2007**). Meanwhile, the study of **Galati *et al.* (2003)** found that prickly pear juice contained a higher amount of approximately 746 mg-liter and the pulp contained 909 mg-liter (**Saenz *et al.*, 2009**). The content of phenolic compounds depends on several factors as follows: category, growth area, climate, ripeness, cultivation practice, storage conditions and extraction methods. These compounds are characterized by their properties for eliminating free radicals and inhibiting fat oxidation (**Noda *et al.*, 2002**).

Several studies showed a strong relationship between phenols and antioxidant activity (**Abou-Ellella and Ali., 2014**). The study conducted by **Awad *et al.* (2018)** found that methanol extract for PPP contain 5 phenolic compounds (Rutin, quercetin, ellagic acid, luteolin, and ascorbic acid). Therefore, polyphenols in waste products can be used as a cheap source of natural compounds and can also be used in the food industry. Replacing artificial food additives with safe and effective natural additives may be more beneficial for food and health alike (**Barbosa-Pereira *et al.*, 2014**).

In general, plant foods are important sources of antioxidants in the diet. Antioxidants help protect cells from the potentially damaging physiological process known as "oxidative stress". This can lead to the emergence of some chronic diseases, including but are not limited to the following: cancer, heart disease, aging and Alzheimer's disease (Ajil *et al.*, 2008). Therefore, it was necessary to make benefit of the dietary fibers of the PPP in the food industry.

Table (18): Phytochemical content and antioxidant activity of prickly pear pears and their products

Measurements	PPP	Cake		t(p)	Biscuit		t(p)
		Control	Cake / PPP		Control	Biscuit/PPP	
Total phenols	438.11 ± 0.19	22.14 ± 0.10 ^a	28.50 ± 0.07 ^b	91.398* (<0.001*)	110.11 ± 0.08 ^a	142.28 ± 0.03 ^b	654.671* (<0.001*)
Carotenoids	215.19 ± 0.78	1.55 ± 0.01 ^a	4.78 ± 0.09 ^b	60.478* (<0.001*)	3.01 ± 0.09 ^a	14.25 ± 0.01 ^b	203.314* (<0.001*)
DPPH%	60.44 ± 0.03	9.60 ± 0.02 ^a	13.08 ± 0.07 ^b	80.384* (<0.001*)	30.08 ± 0.06 ^a	38.10 ± 0.02 ^b	205.956* (<0.001*)

t: Student t-test

PPP: prickly pears peels

Means with **Common letters** are not significant (i.e. Means with **Different letters** are significant)

*: Statistically significant at $p \leq 0.05$

Conclusion

The experimental study results and data analysis revealed high nutritional value and increased antioxidant activity of each of the dried prickly pear peels and their products, Therefore, the study recommends the use of prickly pears peels in different foods to produce foods of high nutritional value, planning media programs and awareness campaigns, holding specialized courses to raise awareness of the importance of using prickly pear peels, which will be reflected on the practices of housewives in the future.

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الملخص العربي

معارف و ممارسات ربات الأسر نحو الاستفادة من قشور التين الشوكي واستخدامه في تدعيم بعض منتجات المخابز (كيك و البسكويت) "دراسة تطبيقية"

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تهدف الدراسة الحالية إلي التعرف على معارف وممارسات ربات الأسر عن قشور التين الشوكي و فوائد وإعادة تدويره و استخدامه في تدعيم بعض المنتجات الغذائية (الكيك و البسكويت). تم إجراء دراستين ؛ الأولى دراسة نوعية من خلال استبيان على عينة من 100 ربة أسرة للتحقيق في معرفة وممارسات المشاركين حول استخدام قشور التين الشوكي. الدراسة الثانية هي دراسة معملية (تطبيقية) تضمنت تحضير واختبار كيك و بسكويت مدعم بقشور التين الشوكي بنسبة 5،10 و 15%. أظهرت نتائج الدراسة: انخفاض مستوي معارف وممارسات ربات الأسر عن الاستفادة بقشور التين الشوكي، كانت هناك علاقة ارتباطية بين مستوي معارف و ممارسات ربات الاسرة عن التين الشوكي و قشوره وبعض الخصائص الاجتماعية والاقتصادية. وجد فروق ذات دلالة إحصائية في كل من المعرفة والممارسات بين المشاركين حسب فئتهم العمرية لصالح من هم فوق 45 سنة. وجد أيضا فروق ذات دلالة إحصائية في المعارف والممارسات لصالح الحاصلين على شهادات جامعية والذين لديهم دخل شهري مرتفع يزيد عن 4000 جنيه ، وكذلك لصالح من يعيشون في المناطق الحضرية و العاملات. من ناحية أخرى أوضحت نتائج التركيب الكيميائي أن قشور التين الشوكي تحتوي على رطوبة ، بروتين ، دهون ، رماد ، كربوهيدرات ، ألياف غذائية وسعرات حرارية بنسب 7.50 ، 4.45 ، 3.54 ، 8.20 ، 76.31 ، 35.88 (جم/100جم) و 354.90 (كيلو كالورى/100جم) على التوالي. كما أظهرت النتائج أن قشور التين الشوكي غنية بالفينولات الكلية والكاروتينات والنشاط المضاد للأكسدة. لوحظ أيضا تحسن في القيمة الغذائية للمنتجات المحضرة من قشور التين الشوكي. أوصت الدراسة بضرورة زيادة معارف وممارسات ربات الأسر حول استخدام قشور التين الشوكي بكافة الوسائل المتاحة.

الكلمات المفتاحية: قشور التين الشوكي - المعارف - الممارسة - التركيب الكيميائي - مضادات الأكسدة.