Utilization of Vegetable Waste Powder in Formulation
Some Egyptian Common Foods

Dalia, H. Eshra1, Jehan, I. Saber2 & Abdel-Nabey, A. A1

1Food Science & Technology Dept., Fac. of Agric., Alex. University, El-Shatby, 21545, Alex., Egypt.
2Home Economics Dept., Fac. of Agric., Alex. University, El-Shatby, 21545, Alex., Egypt

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ABSTRACT
The trimming wastes of some vegetables such as external leaves of lettuce, alcapucci, cabbage, cauliflower (stem & leaves) and artichoke (leaves and outside bracts) were utilized to prepare vegetable - waste powder (VWP). Gross chemical composition, dietary fiber, mineral content, bioactive components, antioxidant activity and antimicrobial activity were studied. Also the utilization of this powder in preparing some Egyptian common foods, such as Falafel, Jew’s mallow stew (Mulukhiya), lentil soup and Bessara as well as some bakery products such as cake and biscuits (Menain) was studied and evaluated from the organoleptic point of view.

The results showed that the VWP contained higher amount of protein, dietary fiber, carotenoids, ascorbic acid and flavonoids. The methanolic extract of powder had antioxidant and antimicrobial activities. The results also showed that all the prepared products containing the different percentages of VWP were well accepted by the panelists.

Keywords: Agro-industrial wastes, vegetable wastes, Egyptian common food products

INTRODUCTION
Food industries produced large amounts of food wastes especially vegetable wastes or by-products. The demand to recover the value through converting these wastes to new products is increased (Helkar et al., 2016, Salim et al., 2017).

Vegetable wastes are good sources of phytonutrients having pharmacological activity. These nutrients include antitumor, antiviral, antibacterial, cardio-protective and antimutagenic (Gupta et al., 2015).

As consumers become incrementally aware of the relation between food and health, their attitude towards healthy food is promising development and the scope of functional foods is increasing all over the world markets (Helkar et al., 2016).

Vegetable wastes can be considered good sources of dietary fiber, antioxidants which may play an important role in food industry and human health (Nawal et al., 2008, Sharoba et al., 2013a).

Antioxidants have an important role in preventing undesirable changes in food flavour and nutritional quality. Also, protect the cells from tissue damage (Nawal et al., 2008). On the other hand, dietary fiber act as protective agent against diverticulitis, constipation, colon cancer, diabetes and cardiovascular diseases (Rodriguez et al., 2006, Sharoba et al., 2013b).

Fruits and vegetables processing, packaging, distribution and consumption generate a huge quantity of fruit and vegetable wastes and most of these wastes are being disposed in the landfills causing environment pollutions. Outer leaves of lettuce, alcapucci, cabbage, in addition to stems and leaves of cauliflowers as well as leaves and outside bracts of artichoke are example of wastes which are removed during the trimming process their done by green grocers before selling these products. These unconventional wastes can act as an excellent source of nutrients capable of inhibiting the activity of some pathogenic microorganisms. In addition, these wastes contain bioactive compounds which can be used as natural antioxidants as well as act as an anticarcinogenic effect. No attention has been done to utilize these wastes in some common food products consumed in Egypt. Thus, the present study aimed to evaluate the composition of these wastes which can help to suggest enormous potentiality for producing value-added products.
MATERIALS AND METHODS

Materials:

Lettuce leaves (Lactuca sativa), alacapucci-lettuce leaves (Brassica oleracea var. ocpitota), cabbage leaves (Brassica oleracea var. botrytis) and artichoke (Cynara codymus) leaves and outside bracts, were obtained from different local markets in Alexandria, Egypt. Wheat flour (72% extraction ratio), baking ingredients (including milk, sugar, oil, eggs, vanillin, baking powder, instant yeast, salt, dry milk), dehulled faba beans, lentil, onion, garlic, fresh and dry coriander, parsley, carrot, tomato and dry Jew’smallow (Mulukhiya) were obtained from local market in Alexandria, Egypt.

Bacterial and fungal strains including: Staphylococcus aerus 29123, Escherichia coli, Rhizopus spp and Aspergillus niger CAIM 147 were utilized. They were obtained from Food technology Department Arid Lands Cultivation Research institute City for Scientific Research and Technological Applications, Alexandria, Egypt.

Preparation of vegetable waste powder (VWP)

All the waste samples were shredded into small pieces, washed with tap water, drained and then dehydrated at 40°C in an air circulating oven for approximately 6 hr. The dehydrated samples were ground and sieved through 60 mesh sieve. Equal amounts of each powder were mixed and the obtained flour was stored frozen at –18°C in tightly closed kilner jars until used.

Technological processes

Preparation of Falafel, Bessara and lentil soup

The traditional methods for preparing Falafel and Bessara were followed as shown in Fig. (1) and described by Youssef et al. (1987).

Traditional method for preparing lentil soup was followed as described by Gafar (1971).

Dehulled faba beans

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Soaking in water (1:3, w/v) for 16 hr at room temp. → Draining → Mincing twice → Addition of salt, spices, parsley, fresh coriander and onion → Fermentation at room temp. for 30 min → Forming into balls (≈15 g each) → Deep-fat frying in sunflower oil at 175°C for 6 min. → Falafel
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Adding of water (1:3, w/v), onion, garlic, vegetables, parsley, fresh coriander and onion → Boiling for 1 hr → Homogenization and sieving → Addition of salt, mixture of spices and fried onion → Pouring into plates → Cooling → Bessara
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Fig. 1: Preparation of Falafel and Bessara
Preparation of Jew’s mallow stew (Mulukhiya)

The procedure of Muna et al. (2016) was followed with some modifications in which dehydrated Mulukhiya was used instead of the fresh ones. Garlic sauce was prepared by heating small amount of butter, garlic and coriander. This sauce was poured immediately into the Mulukhiya.

Preparation of cake and biscuits (Menain).

Cake preparation was done according to Sharoba et al. (2013a). On the other hand, ingredients and procedure for preparing biscuits (Menain) was followed according to the method described by Abdel-Nabey et al. (2013).

The VWP was added to the previous products as follows:

- Bessara (1.25, 2.5, 3.75 and 5.0%).
- Falafel (6.25, 12.5 and 25%).
- Lentil soup (0.25, 0.5, 0.75 and 1%)
- Jew’s mallow stew (Mulukhiya) (20, 40, 60 and 80%).
- Cake (0.5, 1.0 and 1.5%).
- Biscuits (Menain) (0.05, 1.0 and 1.5%)

Analytical methods

Chemical composition.

Moisture, crude protein, crude ether extract and total ash of VWP were determined according to AOAC (2003) unless otherwise stated. Carbohydrate were calculated by difference. Crude fiber, acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined using ANKOM 200 Fiber Analysis ANKOM Technology corporation, NY, USA) according to AOAC (2006). Ascorbic acid was determined according to the AOAC method (2003).

Chlorophylls and carotenoids

Chlorophylls and carotenoids were determined according to Sumanta et al. (2014). The sample (0.5 g of VWP) was homogenized in homogenizer with 10 ml of acetone, 80%. Homogenized sample was centrifuged at 13416 xg for 15 min. The supernatant was separated and 0.5 ml was mixed with 4.5 ml of the solvent. The mixture was analyzed for chlorophyll-a, b and carotenoid content in Optizen pop uv- vis spectrophotometer. The equation used for the quantification of chlorophyll-a, b and carotenoids were as follows:

\[ Ch-a = 12.25 A_{663.2} - 279A_{464.8} \]

\[ Ch-b = 21.5 A_{646.8} - 5.1 A_{663.2} \]

\[ Cx+c = (1000 A_{470} - 1.82 Ca - 85.02 cb) / 198 \]

Where:
- A: Absorbance.
- Ch-a: chlorophyll a.
- Ch-b: chlorophyll b.
- Cx+c: carotenoids.

Extraction of total phenolic compounds from VWP

The VWP was extracted using the method of Vongsak et al. (2013). The dehydrated powder was separately macerated with 70% ethanol (1:40, w/v) for 72 hr at room temperature with occasional shaking. The extract was filtered and the precipitate was re-extracted by the same process and solvent until the extraction was exhausted. The combined extracts were separately filtered through Whatman No.1 filter paper. The extract was dried under reduced pressure at 50°C using a rotary vacuum evaporator. The crude extract was weighed and kept in a tightly closed container protected from light.

Determination of total phenolic compounds

Total phenolic content

Total phenolic content of VWP extract was determined by the method of Moyo et al. (2012) using Folin-Ciocalteu reagent. The extract was mixed with 5 ml Folin – Ciocalteu reagent (previously diluted with distilled water 1:10 v/v) and 4 ml of sodium carbonate (75 g/l). The mixture was vortexted for 15 sec and allowed to stand for 30 min at 40°C for colour development. Absorbance was measured at 765 nm using Optizen pop uv- visspectrophotometer. Total phenolic content was expressed as mg gallic acid equivalent /g.

Total flavonoid content

Total flavonoid content of VWP extract was determined by the method of Zarina & Tan(2013). Firstly, 2 ml of the sample solution was accurately transferred into 10 ml volumetric flask and 0.6 ml of 5% sodium nitrite (NaNO₂) was added. The mixture was shaken and left for 6 min Secondly, 0.5 ml of 10% aluminum nitrate (Al(NO₃)₃ solution was added to the volumetric flask, shaken, and left to stand for 6 min. Finally, 3.0 ml of 4.3 sodium hydroxide (NaOH) solution was added to the volumetric flask, followed by addition of water up
to the scale, shaken, and left to stand for 15 min before determination. Absorbance was measured at 500 nm using Optizen pop uv- vis spectrophotometer. Total flavonoid content was calculated as mg rutin equivalent /g.

Total proanthocyanidin content

Total proanthocyanidin content of VWPe extract was determined by the method of Moyo et al. (2012). Aliquots of 0.5 ml of 1 mg/ml of the extract was mixed with 3 ml of 4 % vanillin-acetone solution and 1.5 ml concentrated hydrochloric acid. The absorbance was measured at 500 nm after the mixture was allowed to stand for 15 min. Total proanthocyanidin content was expressed as mg catechin equivalent /g.

Mineral contents

Minerals including calcium, magnesium, iron, zinc, manganese, chromium, cadmium, copper, nickel and lead were measured as described in AOAC method (2000) using Perkin Elmer 2380 Atomic Absorption spectrophotometer. On the other hand, sodium and potassium were determined using flame photometer (model PFP7, England).

Antioxidant activity

The DPPH radical scavenging assay

The effect of VWPe extract on 1, 1- diphenyl 1-2 picrylhydrazyl (DPPH) radical was estimated using the method described by Moyo et al. (2012). A solution of DPPH (0.135 mM) was prepared and 1 ml of this solution was mixed with 1 ml of the extract. The reaction mixture was vortexed thoroughly and left in the dark at room temperature for 30 min. The absorbance of the mixture was measured at 517 nm using butylatedhydroxyanisole (BHA) as a control. The radical scavenging activity was calculated from the equation:

Percentage of radical scavenging activity = \( \frac{\text{Abs}_{\text{control}} - \text{Abs}_{\text{sample}}}{\text{Abs}_{\text{control}}} \times 100 \)

Where Abs control is the absorbance of DPPH, Abs sample is the absorbance of DPPH radical + sample extract / standard.

The half maximal inhibitory concentration (IC\(_{50}\)) values denoted the concentration of sample required to scavenge 50% of DPPH free radicals is calculated.

Antimicrobial activity

The antimicrobial activity was performed by agar well diffusion method according to El Sohaimy et al. (2015). A well was prepared in the plates with the help of a cork-borer (0.85cm). One hundred µl of the extract (500 mg/ml) was introduced into the well. The plates were incubated overnight at 37°C for bacteria and 25 °C for fungal. Microbial growth was determined by measuring the diameter of zone of inhibition. The result was obtained by measuring the zone diameter (mm). The experiment was done three times and the mean values were expressed. Staphylococcus aureus 29123, Escherichia coli3518, Rhizopus spp and Aspergillus niger CAIM 147 were used.

Sensory evaluation

Colour, taste, odour, texture, (consistency) and overall acceptability of all the products prepared containing the different percentages of VWP were assessed using 15 panelists from Food Science and Technology Department, Faculty of Agriculture, Alexandria university. The panelists were asked to score the above attributes according to a standard hedonic rating score from 9 (like extremely) to 1(dislike extremely) as described by Kramer & Twigg (1973).

Statistical analysis

Statistical package for social science software (SPSS) Version 21using2 factor factorial analysis of variance (ANOVA) was followed. The differences, among means were determined for significance at p≤ 0.05 using Duncan’s multiple range test.

RESULTS AND DISCUSSION

Gross chemical composition and fiber content of VWP

Nowadays, human is being more aware of food related health troubles and interest in using raw materials for producing dietary fiber powder from inexpensive sources such as agro-food industrial wastes such as vegetable wastes. The data in Table (1) shows the proximate chemical composition as well as dietary fiber content of VWP.

It can be noted that the moisture content was 10.79%. On the other hand, the result declared that this powder was a good source of crude protein being 21.52%. Crude ether extract of VWP was very low being 3.19%, while the total ash was 15.4% and total carbohydrate was 59.89 %. In accordance, Esteban et al. (2007) found that the fruit and vegetable wastes contained 65% nitrogen free extract, 13% crude fiber, 12% crude protein, 8% total ash...
Bioactive components and antioxidant activity of VWP

The data in Table (3) show the bioactive components as well as the antioxidant activity of VWP.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value ± S.D. on dry weight basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascorbic acid*</td>
<td>59.09 ± 0.46</td>
</tr>
<tr>
<td>Carotenoids*</td>
<td>35.91 ± 1.42</td>
</tr>
<tr>
<td>Chlorophyll a*</td>
<td>119.49 ± 1.27</td>
</tr>
<tr>
<td>Chlorophyll b*</td>
<td>40.18 ± 1.55</td>
</tr>
<tr>
<td>Total phenolics**</td>
<td>77.87 ± 0.14</td>
</tr>
<tr>
<td>Flavonoids***</td>
<td>1.26 ± 0.15</td>
</tr>
<tr>
<td>Proanthocyanidins±±</td>
<td>0.18 ± 0.05</td>
</tr>
<tr>
<td>DPPH inhibition %</td>
<td>59.42 ± 2.96</td>
</tr>
<tr>
<td>IC₅₀ (mg/ml)</td>
<td>17.03 ± 0.23</td>
</tr>
<tr>
<td>DPPH inhibition %</td>
<td>59.42 ± 2.96</td>
</tr>
<tr>
<td>IC₅₀ (mg/ml)</td>
<td>17.03 ± 0.23</td>
</tr>
</tbody>
</table>

* Mean ± S.D. on dry weight basis
** Gallic acid equivalent
±± Catechin equivalent
equivalent. These results are in agreement with Campas–Baypoli et al. (2009) who found that the stalks of broccoli had nutritional components such as ascorbic acid, β-caroteneoids and phenolic. Gupta et al. (2015) reported that cauliflower wastes including leaves and stems revealed the presence of some flavonoids which could be a feasible strategy to develop functional foods and at the same time would contribute to valorize these wastes. Jimenez–Escriger et al. (2003) mentioned that stems and the external bracts of artichoke which are not suitable for human consumption could be used as a source of inulin, phenolics and should be considered as a raw material for the production of food additives and nutraceuticals.

The antioxidant activity (DPPH inhibition %) as well as IC$_{50}$ (mg/ml) of VWP are shown also in Table (3). These values were 59.42% and 17.03 mg/ml, respectively. These values are mainly due to its high content of phenolic and flavoroids. El-Houfi (2015) and Boriy (2016) extracted and identified phenolic compounds from agro-industrial wastes including pea pod, purslane leaves and stems and studied their antioxidant efficiency on oxidative stability of sunflower oil. They included that the agro as industrial wastes can be considered a natural source of antioxidants which can be exploded to keep the quality of vegetable oils against the rancidity. In addition, Khadiga (2016) found that agro-food industrial wastes including empty pea pods and artichoke bracts showed antioxidant activity comparing with BHT. Also Mabrouk (2017) found that *Moringa oleifera* leaves had an antioxidant activity in which the IC$_{50}$ of the ethanolic extract was 67.77 mg/ml.

**Antimicrobial activity of VWP extract**

The methanolic extract of VWP had an antimicrobial activity against all tested bacterial strains (Fig. 2 and Table 4). The diameter of inhibition zone was 25.1 mm for *E. coli* 3518, and 35.47 mm for *Staphylococcus aureus* 29123.

On the other hand, the results in Table (4) and Fig. (3) showed that the diameter of inhibition zones were 30 mm for *Rhizopus spp* and 32.17 mm for *Aspergillusniger CATM 147*.

Data presented here agree with the results obtained in the study of Abdel-Nabey et al. (2015), El-Sohaimy et al. (2015) and Mabrouk (2017) who found that the leaf powder of *Moringa oleifera* had a noticeable antimicrobial effect on growth of some pathogenic bacteria, molds and yeasts. On the other hand, Khadiga (2016) found that agro-industrial wastes including empty pea pods and artichoke bracts showed antimicrobial activity against some strains of pathogenic microorganisms.

**Sensory evaluation of some common food products containing VWP**

The data in Table (5) show sensory attributes of some common food products such as *Faalafel*, *Muluukiya*, lentil soup and *Bessara* containing different ratios of VWP.

As it can be shown from Table (5), no significant differences were noted in the organoleptic contributes of *Faalafel* containing the different ra-
In case of Mulukhiya, it can be noted that the percentages of VWP added were significantly affected all the sensory attributes in comparison with the control sample. The scores of organoleptic attributes given for Mulukhiya decreased with increasing the % of VWP. In general, all the organoleptic attributes were still over 7.0 which mean that all the Mulukhiya samples prepared containing up to 80% VWP are still accepted by the panelists.

In case of lentil soup, there were significant differences between the control sample and the other samples containing the different % of VWP from the organoleptic point of view. However, there were no any differences between samples containing the different % of VWP. It was obvious that the panelists accepted lentil soup containing the different % of VWP up to 1% (Table 5).

In case of Bessara, there were significant differences on the sensory attributes between the control sample and those containing VWP up to 5%. According to the data obtained (Table 4), the scores of organoleptic attributes slightly decreased with increasing the % of VWP added. However all the samples containing VWP were well accepted by the panelists in which all the scores were above 7.5.

The sensory attributes of some food products such as cake and biscuits (Menain) containing different % of VWP are shown in Table (6) containing different % of VWP. It can be noted with elevating the % of VWP, the organoleptic acceptance declined. This was also true for biscuits (Menain). The data obtained regarding these two products declared that there were slight significant differences between the products containing the different levels (%) of VWP. In general both products were still well accepted by the panelists even at the highest % of VWP added (1.0%).

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**Table 5: Sensory evaluation of Flafel, Mulukhiya, lentil soup and Bessara containing VWP**

<table>
<thead>
<tr>
<th>Product</th>
<th>%VWP</th>
<th>colour</th>
<th>Taste</th>
<th>Odour</th>
<th>Texture</th>
<th>overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flafel</td>
<td></td>
<td>8.06±0.77 a</td>
<td>7.94±0.851 a</td>
<td>7.88±0.89 a</td>
<td>7.75±0.86 a</td>
<td>7.86±0.81 a</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.62±7.88 a</td>
<td>7.75±0.68 a</td>
<td>7.81±0.75 a</td>
<td>7.81±0.75 a</td>
<td>7.81±0.75 a</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>7.63±0.72 a</td>
<td>7.75±0.77 a</td>
<td>7.81±0.83 a</td>
<td>7.81±0.83 a</td>
<td>7.75±0.77 a</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>7.56±0.73 a</td>
<td>≥0.73±7.56 a</td>
<td>7.63±0.89 a</td>
<td>7.5±0.63 a</td>
<td>7.56±0.63 a</td>
</tr>
<tr>
<td>Mulukhiya</td>
<td></td>
<td>8.81±0.40 a</td>
<td>8.50±0.52 a</td>
<td>8.81±0.40 a</td>
<td>8.81±0.40 a</td>
<td>8.81±0.40 a</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>8.00±0.89 b</td>
<td>0.70±7.69 b</td>
<td>8.06±0.85 b</td>
<td>8.81±0.81 b</td>
<td>8.81±0.77 b</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>7.62±0.62 c</td>
<td>7.44±0.63 b</td>
<td>7.63±0.62 c</td>
<td>7.75±0.68 c</td>
<td>0.60±7.69 c</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>7.38±0.72 c</td>
<td>7.31±0.70 b</td>
<td>7.50±0.73 c</td>
<td>7.63±0.81 c</td>
<td>0.63±7.56 c</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>7.38±0.72 c</td>
<td>7.44±0.81 b</td>
<td>7.63±0.81 c</td>
<td>7.44±0.73 c</td>
<td>7.63±0.81 c</td>
</tr>
<tr>
<td>Lentil soup</td>
<td></td>
<td>8.44±0.73 a</td>
<td>8.56±0.63 a</td>
<td>8.50±0.63 a</td>
<td>8.69±0.60 a</td>
<td>8.56±0.63 a</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>7.63±0.62 b</td>
<td>7.56±0.81 b</td>
<td>7.81±0.83 b</td>
<td>7.69±0.70 b</td>
<td>7.69±0.60 b</td>
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<tr>
<td></td>
<td>2</td>
<td>7.63±0.50 b</td>
<td>7.62±0.61 b</td>
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<td>7.50±0.52 b</td>
<td>7.63±0.50 b</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>7.56±0.63 b</td>
<td>7.56±0.73 b</td>
<td>7.75±0.77 b</td>
<td>7.50±0.82 b</td>
<td>7.56±0.63 b</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>7.68±0.60 b</td>
<td>7.63±0.96 b</td>
<td>8.00±0.73 c</td>
<td>7.81±0.91 b</td>
<td>7.56±0.63 b</td>
</tr>
<tr>
<td>Bessara</td>
<td></td>
<td>8.81±0.40 a</td>
<td>8.81±0.40 a</td>
<td>8.75±0.45 a</td>
<td>8.69±0.48 a</td>
<td>8.18±0.40 a</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>8.19±0.75 b</td>
<td>8.13±0.62 b</td>
<td>7.94±0.68 b</td>
<td>8.06±0.86 b</td>
<td>8.06±0.68 b c</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8.06±0.44 b</td>
<td>8.13±0.34 b</td>
<td>8.06±0.57 b</td>
<td>8.19±0.54 b</td>
<td>8.19±0.54 b</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>8.38±0.72 b</td>
<td>8.06±0.57 b</td>
<td>7.94±0.68 b</td>
<td>8.13±0.72 b</td>
<td>8.13±0.72 b</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>7.63±0.62 c</td>
<td>7.81±0.40 c</td>
<td>7.63±0.50 c</td>
<td>7.75±0.58 c</td>
<td>7.75±0.45 c</td>
</tr>
</tbody>
</table>

Means within a column not sharing the same letter are significantly different at $P \leq 0.05$.
Sharoba et al. (2013 a, b) reported that fruit and vegetable wastes including green pea peels can serve as a good source of dietary fiber in cake manufacture. Salim et al. (2017) mentioned that dried products from fruit and vegetable wastes are used as confectionary products, flours, and flakes, granulated, powder, additional ingredient of ready-to-eat soup, salads, energy bars, and cereals, as well as snack products.

As a conclusion, VWP prepared from trimming wastes of some vegetables can be used as a functional ingredient in preparing some common food products such as Falafel, Mulukhiya, lentil soup and Bessara as well as some bakery products such as cake and biscuits (Menain). This is because the VWP can be considered as a source of bioactive components, dietary fiber, antioxidant and antimicrobial agents.

**REFERENCES**


**Table 6: Sensory evaluation of cake and biscuits “Menain” containing VWP**

<table>
<thead>
<tr>
<th>Product</th>
<th>%VWP</th>
<th>Sensory attributes</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>colour</td>
<td>Taste</td>
</tr>
<tr>
<td>Cake</td>
<td></td>
<td>8.69±0.48</td>
<td>8.75±0.44</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>8.19±0.40</td>
<td>8.13±0.50</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>7.69±0.79</td>
<td>7.63±0.81</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>8.19±0.54</td>
<td>8.13±0.34</td>
</tr>
<tr>
<td>Biscuits</td>
<td></td>
<td>8.69±0.48</td>
<td>8.56±0.51</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>8.19±0.66</td>
<td>8.13±0.50</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>7.63±0.50</td>
<td>7.75±0.58</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>7.94±0.57</td>
<td>7.94±0.44</td>
</tr>
</tbody>
</table>

Means within a column not sharing the same letter are significantly different at P≤0.05.


Vongskul, B., Sithisarna, P., Manzmool, S., Thongpraditchote, S., Wongkrajang, Y. & Gritsanapan, W. 2013. Maximizing total phenolic, total flavonoids contents and antioxidant activity of Moringaoleifera leaf extract by the appropriate extraction method. Industrial Crops and Products, 44: 566-571.


الاستفادة من مسحوق مخلط بعض الخضروات في تحضير بعض الأغذية الشعبية المصرية

DALAYA H.S, JIHHAN E.BYHIM SABRY, AHMED ABD AL-NEBI

قسم علوم وتقنية الأغذية جامعته الزراعة- القاهرة الإسكندرية - الشاطئ 21455- مصي

قسم الاقتصاد المنزلي - كلية الزراعة - جامعة الإسكندرية - الشاطئ 21455- الإسكندرية - مصر

استخدمت في هذه الدراسة نواع عملي تشذيب بعض الخضروات مثل الأوراق الخارجية لكل من الخس والكابوتشي والكرنب بالإضافة إلى الأوراق الخارجية وسجاق الفربيط والخرشوف وذلك لتحضير مسحوق من هذه المخلفات. هذا وقد تم تقييم هذا المسحوق من حيث التركيب الكيميائي الإجمالي والألياف الغذائية والعناصر المعدنية ومحتواه من المركبات الحيوية وتثبيثها كمضاد للالتهابات وكمبيد لبعض الفيروسات وكذا الإستفادة من هذا المسحوق بإنزاله بجبوبة مختلفة في بعض الأغذية الشائعة في مصر مثل المخلل والملوخية في الضرية، والكامل، والكابوتشي، والتكويت (المنين).

وقد أوضح الدراسة أن مسحوق هذه المخلفات غني في محتواه من كل من البروتين والألبان الغذائية والكاروتينويدات، حمض الأسكوريك والكاتالوفينودات. كما أن مختصين الايثالي لهذا المسحوق له نشاط مضاد لبعض الفيروسات وكذلك مضاد للأكسدة.

كما أثبتت الدراسة أن جميع المنتجات المحضرة المحتوية على هذا المسحوق وبالنسبة المثيرة كانت مقبلة بدرجة جيدة من الناحية الحسية.