Preparation, Canning and Evaluation Process of Vegetable Mixture Diets (Ready-to-eat) Supplemented with Mushroom

Amira Sh. Soliman[1]; Mohamed S. Abbas[1]; Hassan, F. R. H[2] and Sohier A. Ahmed[*2]
[1] Natural Resources Department, Institute of African Research and Studies, Cairo University, Egypt
[2] Horticulture Crops Technology Research Department, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt

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Abstract: This study was carried out to prepare some formulated different vegetarian diets (Ready to eat) supplemented with mushroom (*Pleurotus ostreatus*). In addition to study the effect of canning process on nutritional, bioactive compounds and free radical scavenging activity. The green peas was substituted with mushroom at 10, 20, 30 and 40% levels for producing some vegetable diet. All mixes and resultant diet samples were evaluated for their physicochemical properties, sensory attributes as well as microbiological tests. The obtained results revealed that the blend (T2) fortified with 20% mushroom in the most favorable. The results showed that the aforementioned, samples are rich in nutrition compounds, vit. B content and free radical scavenging activity which correlated with phenolic and flavonoid compounds. Finally, the resulted data revealed that the formulated vegetable diets filled with tomato juice T recorded the highest nutritional contents, satisfaction and consumer attractiveness followed by those filled with carrot juice C and brine solution S.

***Keywords*:** Canning, vegetables, mushroom, phenolics, flavonoids, antioxidant activity

INTRODUCTION

Lifestyle has undergone tremendous changes. There are many major factors impacts this change has included, liberalization policy, dual income, separate living of couples, Innovative kitchen applications, media proliferation, etc. due to lifestyle pressure nowadays people prefer the easy short way of cooking food rather spending too much time in cooking. There are people, who are migrating to cities for job and education and these people have to find the Ready to eat or cook products are comfortable to eat rather than depending on the restaurants. Often, housewives become the major influential factors in deciding the food products for the whole family. They are now going for purchasing high fiber, low calories and nutrition rich products for their family protection (Vijayabaskar and Sundaram, 2012).

Vegetarian diets are associated with reduced risk of many diseases in health-conscious individuals. The major problem with recommending vegetarian diets for improving health is that a vegetarian diet is inadequately defined in terms of nutrient and food contents. Following the vegetarianism is not only eating plant origins but also formulating a balanced vegetarian diet. Findings from cohort studies to date indicate that increased meat consumption, especially processed meat, is positively and strongly associated with incident cardiovascular, type 2 diabetes, perhaps colon cancer and all-cause mortality which are independent of other lifestyle factors (Pan *et al*., 2012). Additionally, it is not known whether a particular food, dietary compound or a combination of dietary or lifestyle/ behavioral factors in the vegetarian diet provides optimal protection against chronic disease development. It is recognized that over-reliance on one single food, or food group, will not provide the range of nutrients required for optimum health and well-being (Mcevoy *et al*., 2012).

Vegetables and fruits are extremely important in human nutrition as they are important sources of nutrients, dietary fiber, and phytochemicals as well as for the reduction in disease risks (Boeing *et al*., 2012). Vegetables and legumes vary widely in nutrient content so should not be expected to have similar physiological effects. Nutrients in vegetables, such as dietary fiber, vitamins, minerals, and phytochemicals, including polyphenols, all provide support for the biological plausibility that fruits and vegetables play a role in health (Joanne and Beate, 2012). Vegetables, fruits, and other plant-based foods are rich in bioactive phytochemicals that may provide desirable health benefits beyond basic nutrition to reduce the risk of the development of chronic diseases (Liu, 2004). Consumption of fruits and vegetables was associated with lower risk of mortality from cardiovascular disease but not cancer.

The risk of cardiovascular mortality was decreased by 4% for each serving a day of the combined consumption of fruits and vegetables. As for the mechanisms for the inverse association between consumption of fruits and vegetables and cardiovascular mortality, antioxidant compounds, polyphenols, vitamin C, carotenoids, and flavonoids have been shown to prevent the oxidation of cholesterol and other lipids in the arteries and to increase the formation of endothelial prostacyclin that inhibits platelet aggregation and reduces vascular tone (Wang *et al*., 2014). Free radicals may be harmful, leading to inflammation, tissue damage and development of diseases. Free radicals are involved on the pathogenesis of at least 100 different diseases, including cancer, atherosclerosis, rheumatoid arthritis, inflammatory and cataracts (Yahia and Ornelas-Paz, 2010). Humans use several lines of defense against free radicals, including endogenous enzymes and proteins as well as dietary antioxidants. The latter is commonly found in fruits and vegetables and therefore their consumption has been associated with protection against several non-communicable diseases (Harrison and May, 2009).

[*]Corresponding author e-mail: sohierahmed187@yahoo.com

The changes in lifestyle, food habits, high prices of animal protein, low family income, are the main reasons for many nutritional and health problems. Street foods and fast foods are rich in fats, as well as low vegetable consumption, all lead to overweight or obesity and hypercholesterolima and cardiovascular diseases. Also, having foods deficient in protein, micronutrients bioactive compounds causes malnutrition for sensitive groups such as children, adults and pregnant women.

The main objectives of this study were to investigate the possibility to prepare formulated vegetable mixtures diet (Ready to eat) from different vegetables supplemented with mushroom. Moreover, to study the effect of canning process on nutritional, bioactive compounds and scavenging radical activity.

MATERIALS AND METHODS

Materials

Raw Materials

Fresh mushroom fruit bodies of (*Pleurotus ostreatus*) was obtained from mushroom research unit in Food Technology Research Institute (FTRI), Agricultural Research Center (ARC), Giza, Egypt. Seven different vegetables such as convenient maturity green peas (*Pisum sativum*), carrot (*Daucus carota L.*), potatoes (*Solanum tuberosum*), zucchini (*Cucurbita pepo*), red and yellow bell peppers (*Capsicum annuum L.*) at maturity stage of full fruit size and tomato (*Lycopersicon esculentum*) were purchased from local markets, Giza, Egypt.

Chemicals

The utilized chemical materials (solvents, mineral salts, acids etc.) were purchased from El-Gomhorea, Co. for Chemical and Medical Supplies, Cairo, Egypt. Chemicals, solvents and all standard materials which were used for fractionation and identification by HPLC, purchased from Sigma/Aldrich Chemical Company, USA. Folin-Ciocalteu reagent was purchased from LOBA Chemie, India.

Methods

Technological methods

Preparation of different formula

All ingredients were washed, sorted and prepared as follow: mushroom fruit bodies were vertically halved through the stem with a sharp knife, blanched in Sodium chloride (NaCl) 0.1% solution at 98±2ºC for 2 min. Immature, dry and damaged green peas pods were removed manually by visual inspection, then seeds were separated and blanched in boiled water at 98±2ºC for 5 min. The carrots were prepared by washing, sorting, trimming, peeling, cutting into approximate cubes (1 cm^3), and blanched with steam for 15 min. Potatoes were peeled and cut into cubes (1 cm^3) before blanching in boiled water at 98±2°C for 2 min. Green zucchini was prepared by cutting off the top and bottom ends with a knife, washed and cut into cylindrical pieces and blanched with steam for 5 min. The whole bell-pepper pods (red and yellow) were approximately unified square pieces 10.0±0.1 mm and blanched with steam for 5 min. then cooled down. All prepared vegetables were cooled down and kept until used for preparation vegetable mixture blends (ready to eat diet).

Preparation of different filling solution

- Sodium chloride solution (NaCl) 2%
- Carrot juice: The whole carrot was washed, peeled and cut into longitudinal halves. The juice was mechanically extracted by Blender (Braun type: 4290 made in Germany). The extracted juice was screened and acidified using citric acid solution to achieve the pH value around 5 (Alison *et al*., 2014). Carrot juice was used immediately for pouring in blend containers.
- Tomato juice: Raw fresh tomato fruits were washed and chopped into pieces with a knife. The juice was mechanically extracted by Blender (Braun type: 4290 made in Germany). The extracted juice was screened and used immediately for pouring in blend containers.

The filling solutions were mixed with 0.1% citric acid, 0.1% sodium benzoate, and 0.1% ascorbic acid and boiled before poured.

Preparation of different products

The vegetable mixture formulae were produced throughout many preliminary experiments. These resultant formulae were screened due to their sensory attributes. According to organoleptic evaluation, the most favorable formula was chosen and referred to as control blend. The control vegetable blend was composed of: green peas (55%), carrots (15%), green zucchini and potatoes (10% for each) and red and yellow bell pepper (5% for each). Then the previously chosen vegetable (control) blend was fortified with Pleurotus mushroom at different levels (0-40%, these percent was based on preliminary results substituting from green peas percentage) in form of ready to eat diet. Five formula including control (T1 – T4) were prepared. The ingredients of different formula are illustrated in Table (1).

The ingredients of each diet formula (Table 1) were filled in glass jars (80 g). Hot sodium chloride 2% solution (brine) was poured 90±2ºC in jars as filling medium (as it the most common) to cover the filled materials. Then the jars closed tightly and pasteurized using water bath at 100ºC for 30 min., cooled down. The five vegetable blends were sensory evaluated immediately after processing to define the most acceptable formulae. The most favorable vegetable blend only was chosen to complete the course of the study using carrot juice (represent as C blend), tomato juice (represent as T blend) and brine (represent as S blend) as filling medium and stored at 5±2ºC.

Analytical methods

Chemical analysis

Vegetarians blend or ready-to-eat diets were subjected to chemical analysis (moisture, crude protein, crude lipids, ash, and crude fiber according to methods of AOAC (2012). However, the carbohydrates content was determined by difference according to FAO (2003). The total carotenoids were determined in the samples according to Askar and Treptow (1993). Total phenols were determined using the Folin–Ciocalteu method according to Singleton and Rossi (1965). Total flavonoids content was measured by $AlCl_3$ colorimetric assay according to the method of Tacouri *et al*. (2013). The radical scavenging ability of samples was determined in the samples according to Brand-Williams *et al*. (1995). B-Complex vitamins were determined according to the method described by Batifoulier *et al*. (2005).

Table (1): Ingredients of the vegetable formula

Ingredients (%)	Treatments				
	Control	T1	T2	T3	T4
Mushroom	0	10	20	30	40
Green peas	55	45	35	25	15
Carrot	15	15	15	15	15
Green zucchini	10	10	10	10	10
Potatoes	10	10	10	10	10
Red pepper	5	5	5	5	5
Yellow pepper	5	5	5	5	5
Total	100	100	100	100	100

Microbiological evaluation

Plate count agar media was used for detecting the total microbiological count according to APHA (1992). A known volume of sterile sample (1 ml) was added to petrel-plates were incubated at 37°C for 48 hr. The total bacterial count was recorded as colony forming unit (CFU) per gram of samples.

Sensory evaluation

The ready-to-eat diets were sensory evaluated according to the method described by Aishah and Wan Rosli (2013). Sensory panels were randomly selected from Food Technology Research Institute staff. Sensory forms with seven-point hedonic scales (7 being like extremely, 4 like accepted and 1 dislike extremely) were used to differentiate the panel preferences degree of liking. Five attributes namely color, odor, appearance, flavor and overall acceptability were evaluated.

Statistical Analysis

The obtained data from chemical properties were exposed to the analysis of variance. Duncan's multiple range test at ($p \leq 0.05$) level was used to compare between means. The analysis was carried out using the ANOVA procedure of Statistical Analysis System (SAS, 1998).

RESULTS AND DISCUSSIONS

The chemical composition of raw materials

The materials used in this investigation were mushroom fruit bodies; vegetables green peas, yellow carrot, potatoes, zucchini, red and yellow bell peppers and tomato. The raw materials were chemically analyzed for their contents of crude protein, crude fiber, ash, crude fat and total carbohydrates. The obtained data are shown in Table (2). Protein content considers the most important component in any food item from the nutrition point of view. In this concern, the tested raw materials showed great variations in their protein contents which ranged from 7.49 to 25.86% on dry weight basis.

The maximum crude protein was found in green peas (25.86 %) and mushroom (24.92%) which differed significantly than all tested raw materials as expected. These results agree with those obtained by Mateus *et al.* (2012) and Ganzon-Naret (2013) who reported that the protein content was 19.40-28.60% for mushroom and 24.1% for green peas.

Vegetables usually contain relatively high amounts of crude fiber. Results in Table (2) revealed that potatoes contained the lowest level of crude fiber (2.74%). In contrary, the high levels of the crude fiber were found in mushroom, tomato, zucchini and red pepper being 21.53, 10.21, 8.56 and 8.41%, respectively, which followed by yellow pepper (8.08%). The crude fiber content of other raw materials ranged from 7.38 to 7.84%.

Vegetables are rich in ash and important minerals. From the results represented in Table (2), the red pepper, yellow pepper, green peas, and potatoes had low levels of ash as follows: 3.71, 3.92, 4.15 and 4.48%, respectively, while tomato had the highest level of ash (10.16%). The ash content of zucchini, mushroom, and carrot ranged from 6.06 to 6.29%. These results are in agreement with those obtained by Kaushal *et al.* (2011) and Sharma and Joshi (2014) who found that ash content ranged from 2.65 to 3.14% for bell pepper, Nikolopoulou *et al.* (2007) 3.05-4.06 for green peas, Dorota *et al.* (2011) 3.95-4.71 for potatoes, Kenneth (2016) 7.69-11.11% for zucchini, Demir *et al.* (2007) 7.34% for carrot and Michael *et al.* (2011) 7.0% for mushroom.

Usually, vegetables contain lower content of fats. The lowest crude fat level was observed in potatoes (0.454%) followed by green peas (1.40%) and carrot (1.45%). While the highest fat level was found in tomato (4.80%). Also, the fat content in mushroom, zucchini, red pepper and yellow pepper ranged from 1.88 to 2.34%. These results are in good harmony with the results previously obtained by many investigators; who found that fat content ranged from 0.98 to 3.12% in potatoes (Dorota *et al*., 2011), 1.2% for green peas (Ganzon-Naret, 2013), 1.66% for carrot (Januskevicius *et al*., 2012), 1.34-6.45 for mushroom (Beluhan and Ranogajec, 2011), 1.89 for zucchini and 2.33-2.75 for red pepper and yellow pepper (Januskevicius *et al*., 2012).

Vegetables are well recognized that contain high amounts of carbohydrates. From the results, as shown in Table (2), it could be noted that the total carbohydrates in mushroom was 67.17%. However, the potatoes had the highest total carbohydrates (87.57%). These results are in agreement with the results of Beluhan and Ranogajec (2011) who mentioned that the total carbohydrates content ranged from 42.62-66.78% for mushroom and Pedreschi *et al.* (2008) 82.4% for potatoes. Also, carrot, red pepper, and yellow pepper had a high content of total carbohydrates being 82.95, 82.28 and 82.21%, respectively. These results are in agreement with the results found by Rafiq *et al.* (2016) 81.82% for carrot, USDA (2016) 79.20-80.87 for red and yellow pepper, respectively. Data in the same Table declare that the total carbohydrates in tomato, green peas and zucchini were 68.02, 68.59 and 77.74%, respectively. These results coincide with the data obtained by USDA (2016), 70.98% for tomato and 68.35% for green peas and results obtained by Bello *et al*. (2014) 74.20% for zucchini.

Table (2): The chemical composition (mean±SD) of different ingredients used

Ingredients	**Chemical composition %**				
	Crude protein	**Crude fiber**	**Ash content**	**Crude fat**	**Total carbohydrates**
Mushroom	24.86^{b} ±0.61	21.53^{a} ±0.17	6.09^{b} ±0.10	1.88^{d} ±0.06	67.17^{f} ±0.55
Green peas	25.86^{a} ±0.47	7.84^{d} ±0.13	4.15^{d} ±0.16	1.40^{e} ±0.05	68.59^{e} ±0.42
Carrot	9.30^{e} ±0.09	7.38^{e} ±0.05	6.29^{b} ±0.25	1.45^{e} ±0.05	82.95^{b} ±0.27
Potatoes	7.49^{f} ±0.16	2.74^{f} ±0.08	4.48^{c} ±.0.11	0.454^{f} ±0.06	87.57^{a} ±0.01
Zucchini	14.29^{c} ±0.60	8.56^{c} ±0.44	6.06^{b} ±0.08	1.91^{cd} ±0.07	77.74^{d} ±0.13
Red pepper	11.92^{d} ±0.18	8.41^{c} ±0.19	3.71^{f} ±0.14	2.10^{c} ±0.11	82.28^{c} ±0.38
Yellow pepper	11.53^{d} ±0.17	8.08^{cd} ±0.18	3.92^{ef} ±0.10	2.34^{b} ±0.05	82.21^{c} ±0.39
Tomato	17.02^{c} ±0.81	10.21^{b} ±0.27	10.16^{a} ±0.26	4.80^{a} ±0.30	68.02^{e} ±0.62

Means within a column showing the same letters are not significantly different ($P \leq 0.05$)
Values were calculated on dry weight basis

As for total phenolic compounds, it could be observed that potatoes and green peas contained the lowest content of total phenolic compounds (3.94 and 4.35 mg/g.), respectively. These results are in agreement with Dorota *et al*. (2011) 2.12-3.37 mg/g. for potatoes and Amarowicz *et al*. (2001) 2.6 to 9.2 mg/g. for green peas. Meanwhile, red pepper had the highest content of total phenolic compounds (47.34 mg/g.) followed by zucchini (28.05 mg/g.), yellow pepper (26.19 mg/g) and mushroom (25.28 mg/g). These results nearly coincide with the results previously obtained by many investigators; Luis Angel *et al*. (2012) for red and yellow pepper, Eissa *et al*. (2013) for zucchini and Babita and Narender (2014) 5.9-16.81 for mushroom.

Total phenolic compounds (TPC) content of carrot and tomato were 9.91 and 18.09 mg/g, respectively. These results are slightly higher than those found by Goncalves *et al*. (2010) for carrot and Marsic *et al*. (2011) who mentioned that the total phenolic content of tomato ranged from 8.60 to 10.39 mg/100g (FW). Differences in values of (TPC) in this study from those reported in the literature may be due to different cultivars and/or different extraction methods.

Concerning flavonoids, the determined results revealed that the potatoes, green peas, carrot, mushroom and red pepper had low total flavonoid contents being 0.93, 1.38, 1.51, 1.71 and 1.76 mg/g, respectively. These results are in accordance with Dorota *et al.* (2011) 0.7-1.0 mg/g for potatoes, Bembem and Sadana (2014) 5.7 mg/100g (FW) for carrot, Babita and Narender (2014) 1.36-1.76 mg/g for mushroom and Luis Angel *et al*. (2012) 25.38-60.36 mg/100g (FW) for red pepper.

On the contrary, tomato and yellow pepperhad the highest content of total flavonoids (3.13 and 3.11 mg/g). These results coincide with those reported by Luis Angel *et al*. (2012) for yellow pepper and El-Dengawy *et al*. (2016) who mentioned that, the total flavonoids content was 6.43 mg/kg (FW) for tomato while zucchini contained 2.35 mg/g, as shown in Table (3).

Table (3): Total phenolics, total flavonoid contents and scavenging activities of vegetables (mean±SD)

Ingredients	*Total phenolics (as Gallic acid) mg/g	*Total flavonoids (as Quercetein) mg/g	DPPH•-scavenging activity (%)
Mushroom	25.28^{d} ±0.56	1.71^{c} ±0.07	69.80^{d} ±0.43
Green peas	4.35^{g} ±0.11	1.38^{d} ±0.08	64.88^{e} ±0.52
Carrot	9.91^{f} ±0.12	1.51^{cd} ±0.07	64.71^{e} ±0.66
Potatoes	3.94^{g} ±0.23	0.93^{e} ±0.03	79.84^{a} ±0.74
Zucchini	28.05^{b}±0.20	2.35^{b} ±0.31	82.33^{a} ±0.37
Red pepper	47.34^{a} ±0.55	1.76^{c} ±0.13	74.12^{c} ±0.87
Yellow pepper	26.19^{c} ±0.25	3.11^{a} ±0.27	78.07^{b} ±0.80
Tomato	18.09^{e} ±0.50	3.13^{a} ±0.25	59.38^{f}±0.79

Means within a column showing the same letters are not significantly different (P≤ 0.05)
*Values were calculated on dry weight basis

Scavenging of the stable DPPH radical was widely used to evaluate antioxidant activity of phenolic compounds extracted from fruit and vegetables, cereal, grain. Data in Table (3) indicated that the antioxidant activity, obtained for zucchini, potatoes, yellow pepper, and red pepper were 82.33, 79.84, 78.07 and 74.12%, respectively. While, radical activities scavenging for tomato, carrot, green peas, and mushroom ranged from 59.38 to 69.80%. Zhang and Hamauzu (2003) reported that the difference in the antioxidant activity could be explained by differences in carotenoid, phenolic, and flavonoid contents contained in the materials.

Sensory evaluation showed that generally the products get satisfied scores in most quality attributes and was acceptable. Results in Table (4) showed that the addition of mushroom to vegetable mixture blend (control) at levels less than 20% or more than 30% (substitute of green peas) was less favorable compared to T2 and T3. Also, the results obviously indicated that no significant differences were detected between T2 (fortified with 20% mushroom) and T3 (fortified with 30% mushroom) in all evaluated sensory attributes.

Table (4): Effect of mushroom (%) addition on sensory attributes (mean±SD) of the vegetable blend

Mushroom%	Color	Taste	Odor	Appearance	Overall acceptability
Control (0)	3.60^{c}±0.84	4.20^{b}±1.03	4.50^{b}±0.53	4.45^{c}±0.73	4.19^{b}±0.29
T1 (10)	4.00^{bc}±0.67	4.15^{b}±0.75	4.40^{b}±0.62	5.10^{b}±0.78	4.43^{b}±0.35
T2 20)	5.90^{a}±0.66	6.10^{a}±0.57	6.00^{a}±0.78	6.15^{a}±0.58	6.05^{a}±0.35
T3 (30)	5.60^{a}±0.52	6.00^{a}±0.58	5.55^{a}±0.80	5.85^{a}±0.53	5.75^{a}±0.45
T4 (40)	4.50^{b}±0.67	4.70^{b}±0.79	3.90^{b}±0.66	4.35^{c}±0.63	4.37^{b}±0.50

Means within a column showing the same letters are not significantly different (P≤ 0.05)

It is mean that, addition of more mushroom to the vegetable blends than 20% not significantly enhance the quality attributes of that blends. So, from the economic point of view, the blend T2 (fortified with 20% mushroom) is the most favorable blend and chosen to continue to the rest of the study. Meanwhile, the other, vegetable blends (T1, T3, T4, and control) were excluded. The chosen vegetable mixture fortified with 20% oyster mushroom was canned with carrot juice (C blend), tomato juice (T blend), along with brine solution (S blend) as filling solutions.

Effect of canning process with different filling solutions on chemical composition of the vegetable diet

Vegetables contain most, if not all, of the essential components of human nutrition. Nutrients have traditionally been viewed as food components that either cannot be synthesized in the body or whose synthesis requires a specific factor that may in certain circumstances be absent or inadequate (for example, some amino acids, fatty acids, and vitamins), (Prior and Cao, 2000). Nutritive constituents of protein, crude fiber, fat, ash and total carbohydrate, as well as phenolic compounds, flavonoids, and antioxidant activity % were determined in vegetable blends, and the obtained data were recorded in Table (5). It could be noted that the crude protein content of the ready to eat diet was 21.32% in T blend, 20.51% in C blend and 19.66% in S blend, respectively.

The protein content in T blend was significantly higher than the S blend, however, no significant difference ($p \leq 0.05$) has been found between formulated diets T and C, Table (5). In the same context, crude fat content was 2.59% in (T) blend. While, C and S blends contained 2.22 and 1.89% crude fat, respectively. Data presented in Table (5) showed that the formulated diets had a significant difference ($p \leq 0.05$) between them in ash and crude fiber contents. The total carbohydrates content varied from 70.62 to 73.63 in formulating diets, these results indicate that T blend had the lowest total carbohydrates.

Table (5): Effect of different filling solutions on chemical composition (mean±SD) of vegetable diets

Characteristics	C	T	S
***Crude protein %**	20.51^{ab} ±0.55	21.32^{a} ±0.43	19.66^{b} ±0.33
***Crude fiber %**	5.95^{b} ±0.03	6.73^{a} ±0.08	5.07^{c} ±0.17
***Ash %**	4.00^{c} ±0.21	5.47^{a} ±0.25	4.82^{b} ±0.16
***Crude fat %**	2.22^{b} ±0.03	2.59^{a} ±0.04	1.89^{c} ±0.06
***Total carbohydrates %**	73.27^{b} ±0.64	70.62^{c} ±0.75	73.63^{a} ±0.44
***Total phenolics (as Gallic acid) mg/100g**	68.38^{b} ±0.84	74.34^{a} ±0.33	61.32^{c} ±0.49
***Total flavonoids (as Quercetin) mg/100g**	35.39^{a} ±0.14	35.20^{a} 0.41	30.96^{b} ±0.50
DPPH•-scavenging activity (%)	83.44^{a} ±0.09	84.47^{a} ±0.86	81.77^{b} ±0.41

Means within a row showing the same letters are not significantly different ($P \leq 0.05$)
*: Calculated on dry weight basis; C: Vegetables blend with carrot juice;
T: Vegetables blend with tomato juice; S: Vegetables blend with a salt solution

While, S blend had the maximum total carbohydrates content. Meanwhile, total phenolic compounds (as Gallic acid) C, T and S blends were 68.38, 74.34 and 61.32 mg/100 g, consecutively. The total flavonoids for C, T and S blends were 35.39, 35.20 and 30.96 mg/100 g, respectively. Concerning the antioxidant activity of canned vegetable blends C, T and S blends it was found to be 83.44, 84.47 and 81.77%, respectively. Vegetable blend S had the lowest antioxidant activity while no significant differences between C and T blends.

From the above mentioned data, it could be concluded that, using tomato juice as filling solution (T blend) was higher in crude protein, crude fat, crude fiber, ash, total phenolic compounds, total flavonoids and antioxidant activity than those filled in carrot juice or brine solutions C and S blends. Also, the results indicated that, no significant differences between C and T blends in crude protein, total flavonoids, and antioxidant activity.

Effect of canning process and filling solutions on B complex vitamins of canned vegetable diet

The B vitamins are essential nutrients that support carbohydrates metabolism, enhance immune system function, and promote cell growth (Adejumo, 2012). Fortification of foods is current interest because of increasing nutritional awareness among consumers. Vegetables can be easily fortified with nutritional compounds to provide convenient foods, in order to supplement vitamin in the diet and nutrition. The amount of vitamin B3 (Nicotinic) in formulated diets, vegetable samples ranged from 2584.18 to 10079.82 mg/kg (Table 6).

The highest content of vitamin B3 was found in T blend. Among all vegetable diets, vitamin B2 (Ribolavine) was lowest in S diet (98.98 mg/kg). The highest amount of vitamin B2 (434.54 mg/kg) was estimated in T diet. The highest content of vitamin B1 (Thiamine) was present in vegetable diet T which were (72.19 mg/kg). While, C and S vegetable diets contained 44.80 and 52.34 mg/kg of vitamin B1, respectively.

Furthermore, pyridoxine content in C blend was 56.26 mg/kg. While, it's content in T and S blends were 48.16 and 30.20 mg/kg, respectively. However, the levels of the other two vitamins, B9 (Folic) and B12 (Cobalamin) differed between C, T and S blends being 66.26, 29.26 and 23.15 mg/kg and 12.15, 12.27 and 5.46 mg/kg, respectively. From the aforementioned data, it could be concluded that investigated vegetable and its blends are considered to be rich sources of B complex vitamins and had a necessary bio-components that play a great role to protect human body.

Table (6): Effect of canning process and filling solutions on B complex vitamins (mg/kg) of canned vegetable diet

B complex vitamins	C	T	S
Nicotinic (B3)	7257.94	10079.82	2584.18
Thiamine (B1)	44.80	72.19	52.34
Pyroxidin (B6)	56.26	48.16	30.20
Folic (B9)	66.26	29.26	23.15
Cobalamin (B12)	12.15	12.27	5.46
Ribolavine (B2)	296.18	434.54	98.98

Calculated on dry weight basis; C: Vegetables blend with carrot juice;
T: Vegetables blend with tomato juice; S: Vegetables blend with a salt solution

Organoleptic properties of canned vegetable diet (ready-to-eat)

The organoleptic attribute and the nutritional value of vegetable products are factors critical to consumer acceptance and the success of these products. The effects of processing techniques and treatments on sensory quality, including the appearance, color, flavor (taste and odor) of vegetables, and fruits are evaluated. It is useful in product improvement, quality maintenance and more important in a new product development. Hedonic sensory analysis relates to pleasant and unpleasant states of an organism. In hedonic scaling affective ratings of preference or liking and disliking are measured (Land and Shepherd, 1988).

Canning induces changes in flavor, color, and texture, usually in desirable ways, but sometimes in undesirable ways. Table (7) revealed that, vegetables supplemented with mushroom and filling in different solutions non significantly ($p \leq 0.05$) affects color, odor, appearance attributes and overall acceptability. But, it had a significant effect on the taste between T diet and C and S diets. The T diet recorded the highest score of the taste.

Table (7): Organoleptic properties (mean±SD) of canned vegetable diet (ready-to-eat)

Blends	Color	Odor	Taste	Appearance	Overall acceptability
C	6.20^{a} ±0.63	6.00^{a} ±0.67	6.00^{ab} ±0.67	6.35^{a} ±0.50	6.14^{a} ±0.46
T	6.20^{a} ±0.79	6.40^{a} ±0.52	6.30^{a} ±0.48	6.45^{a} ±0.43	6.34^{a} ±0.65
S	6.10^{a} ±0.88	5.90^{a} ±0.74	5.75^{b} ±0.59	6.15^{a} ±0.47	5.96^{a} ±0.55

Means within a column showing the same letters are not significantly different ($P \leq 0.05$)
C: Vegetables blend with carrot juice; T: Vegetables blend with tomato juice;
S: Vegetables blend with a salt solution

Microbial population of canned blends

The canned vegetable blend samples were evaluated for the presence of viable microbial counts immediately after processing and during storage for 6 months under cold conditions (5±2ºC). The results in the Table (8) indicated that the microbial counts including total plate count were not detected in the canned sample after processing in zero time. The absence of microbial counts was because of the severity of thermal treatment during processing, thus all samples were pasteurized, also the safety and hygiene procedures follows throughout the formulation and canning process.

The thermal treatment was, therefore, adequate to achieve commercial sterility and hence the safety of product as reported by Rather *et al.* (2017). Also, this might be due to the preservative effect used like sodium benzoate. Meanwhile, no microorganisms were detected even after 3 months of storage for samples stored under cooling conditions. However, the very low counts noticeable after 6 months. Nonetheless, the total plate counts observed in the present samples were below the permissible limits (10^3/g and 10^4/g) set by the International Commission for Microbial Specifications for foods.

Table (8): Effect of storage periods on microbial population of canned blends (CFU/g)

Storage periods (month)	Total viable plate count		
	C	T	S
Zero time	ND	ND	ND
3 months	ND	ND	ND
6 months	< 100	< 100	< 100

ND: Mean not detected; CFU: Colony forming unit;
C: Vegetables blend with carrot juice; T: Vegetables blend with tomato juice; S: Vegetables blend with a salt solution

CONCLUSION

The current study concluded that the prepared diets from investigated vegetables supplemented with mushroom as a valuable food addition resulted in a highly acceptable, nutritious, delicious ready to eat diet. This diet meets the changes in the present day consumers' lifestyle which have led to a vital change in the marketing trends of the food sector. It also, highly encourages the consumption of vegetables for their importance for micronutrient and macronutrient and their health benefits as recommended by FAO/WHO Expert Consultation on diet.

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إعداد، تعليب وتقييم وجبات من خليط الخضروات مدعمة بعيش الغراب (جاهزة للأكل)

أميرة شوقى سليمان[١]، محمد سعيد عباس[١]، فتحى رجب حسين حسن[٢] و سهير عبد الله أحمد[٢]

[١] قسم الموارد الطبيعية، معهد البحوث والدراسات الأفريقية، جامعة القاهرة، مصر

[٢]قسم بحوث تكنولوجيا الحاصلات البستانية، معهد بحوث تكنولوجيا الأغذية، مركز البحوث الزراعية، جيزة، مصر

تهدف هذه الدراسة لإعداد بعض وجبات الخضر المختلفة (جاهزة لأكل) عن طريق تدعيم هذه الوجبات بعيش الغراب بالإضافة إلى دراسة تأثير عمليات التعليب على المكونات الغذائية، المركبات النشطة بيولوجيا والمقدرة على كبح الشقوق الحرة. تم استبدال البازلاء الخضراء بعيش الغراب بنسب (١٠، ٢٠، ٣٠ و ٤٠%) في إنتاج بعض خلطات الخضر المختلفة. ولقد اختبرت الخلطات والمنتجات المجهزة من حيث الخواص الفيزوكيميائية والحسية بجانب الاختبارات الميكروبية. ودلت النتائج المتحصل عليها أن أفضل الخلطات هي الخلطة رقم (٢) المدعمة بنسبة٢٠% من عيش الغراب. كما أظهرت النتائج أن العينات السابقة الذكر غنية بالمكونات الغذائية، فيتامين (ب) والقدرة على كبح الشقوق الحرة الذي يرتبط بمحتواها العالي من المركبات الفينولية والفلافونويد. وأخيراً أشارت النتائج أن وجبة الخضروات المجهزة والمعبئة في وسط تعبئة من عصير الطماطم سجلت أعلى محتوى من المكونات الغذائية وكانت أكثر قابلية وجاذبية للمستهلك يتبعها الخلطات المعبئة في وسط تعبئة من عصير الجزر ثم المحلول الملحي.