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EVALUATION OF PREPARED DIFFERENT VEGETARIAN FORMULAS

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ABSTRACT

Interest in vegetarian diets is growing due to their healthy benefits. In this study, twelve vegetarian diets were formulated from different vegetables such as cauliflower, green pea, green bean and green squash with different protein sources such as faba bean, chickpea and soybean flour as well as some other fixed ingredients. The twelve vegetarian diets which performed as ready-to-use and ready-to-eat were analyzed for their proximate composition, caloric value, minerals content, vitamins, phyto-pigments and antioxidant activity. In addition, the microbiological attributes such as total viable count, coliform group, *Escherichia coli* and molds and yeasts were enumerated. Moreover, all vegetarian diets were subjected to sensory evaluation using ٧-hedonic scale toward (appearance, texture, taste, odor, juiciness, and overall acceptability) with ٤٠ panelists.

Results of composite analysis indicated ٦٧,٥٢ to ٧٣,٥٤, ٢٩,٨٢ to ٣٥,٨٨, ٢,٦٣ to ٣,٢٩, ٥,٩١ to ٨,٢٦, ٧,٠٦ to ١٣,٦٤ and ٤٠,٤٦ to ٥٤,١٢٪ for moisture, crude protein, lipids, ash, crude fiber and carbohydrates contents in fresh diets, respectively. After frying, moisture ranged from ٤٢,٥٦ to ٥٤,٢٣٪ and lipids ranged from ١٩,٧٢ to ٢٦,٧٦٪. Accordingly, crude protein, ash, crude fiber and carbohydrates contents ranged from ١٨,٦٠ to ٢٥,٦٢, ٤,٩٧ to ٧,٢٧, ٥,٨٦ to ١٢,٨٦ and ٣٣,٥٧ to ٤٩,٢٨٪, respectively. All formulated vegetarian diets were rich in the minerals content. Significant differences (P<٠,٠٥) were found between macro- and micro-nutrients content of both fresh and fried vegetarian diets. All fresh formulas exhibit appropriate content of vitamin C, chlorophyll a, b and carotenoids which basically depends on the ingredients. Frying process dramatically influenced vitamin C, chlorophyll a, b and carotenoids contents. The lost were ٩١,٠٢, ٧٩,٨٤, ٥٥,٧٩ and ١٥,١٤٪, respectively. Significant differences (P<٠,٠٥) were found in total phenolic compounds content and the antioxidant activity among the most prepared formulas in either fresh or fried vegetarian diets. In addition, the highly consumer acceptability of prepared vegetarian diets confirmed that chickpea formulas were best prepared vegetarian diets. Significant differences (P<٠,٠٥) in the overall acceptability mean value were found between chickpeas formulas and other formulas. The total viable count of fried diets was very low comparing to the fresh formulas. Whereas no coliform groups, *Escherichia coli* and molds and yeasts have been detected. Finally, the possibility of producing healthy vegetarian diet formulas using common vegetable kinds and protein sources could provide promising approach for improving the traditional meals and human health.

Keywords: Vegetarian diet, vegetables, proximate composition, sensory evaluation, carotenoids, antioxidant activity.

INTRODUCTION

Our food choices do not only affect our own health, but also the health of our ecosystems as well. However, ready-to-eat meat and processed meat consumption have been associated with increase the risk of many diseases. Recently, researchers from the Harvard School of Public Health have found that eating processed meat such as bacon, sausage or

processed deli meats was associated with a ٤٢٪ higher risk of heart disease and a ١٩٪ higher risk of type ٢ diabetes (Micha *et al.,* ٢٠١٠).

In the recent years, the meat substituting industry was highly encouraged to reduce the meat consumption and thereby reduce the risk of related disease. Purely, substituting consumption of meat by alternative protein rich products made from plant proteins, so-called Novel Protein Foods, would be an attractive option (Jongen and Meerdink, ٢٠٠١). However, consumption of meat substitute products as a meal component are still very low compared to meat and poultry products, therefore it is not yet considered as absolute alternative for meat to the majority of consumers, except for vegetarians (PVE, ٢٠٠٣). Just recently in the nineties, new meat substitute products such as Tivallw or Quornw became widely available in Europe (Davies & Lightowler, ١٩٩٨ and McIlveen *et al.,* ١٩٩٩).

Traditional vegetarian products such as tofu and tempeh have been consumed for centuries in Asian countries. The term 'vegetarian' is not very straight forward, but it generally describes a range of diets that avoids animal flesh (meat, fish and poultry), with varying degrees of restriction (Silverstone, ١٩٩٣ and British Nutrition Foundation, ١٩٩٥). A vegetarian is a person who consumes a diet consisting mostly of plant-based foods including fruit, vegetables, legumes, nuts, seeds, and grains. Whereas, vegetarian diets have been classified in four main types: (١) lacto-ovo vegetarian that eats dairy foods and eggs but not meat, poultry or seafood, (٢) lacto-vegetarian that eats dairy foods but not eggs, meat, poultry or seafood, (٣) ovo-vegetarian that eats eggs but not dairy foods, meat, poultry or seafood and (٤) vegan that does not eat any animal products including meat, poultry, seafood, eggs and dairy foods (Marsh *et al.,* ٢٠٠٩).

Vegetarian diets are not only associated with a decreased frequency of meat consumption but also with a particular belief or lifestyle (Kenyon & Barker, ١٩٩٨; Worsley and Skrzypiec, ١٩٩٨ and Kalof *et al.,* ١٩٩٩). Once appropriately vegetarian diets are often associated with a number of health advantages, including lower blood cholesterol levels in adults and children (Krajcovicova-Kudlackova *et al.,* ١٩٩٧), lower risk of heart disease (Fraser, ١٩٩٩), lower blood pressure levels and lower risk of hypertension and type ٢ diabetes (Sacks & Kass, ١٩٨٨ and Micha *et al.,* ٢٠١٠). Vegetarians tend to have a lower body mass index (BMI) and lower overall cancer rates. Vegetarian diets tend to be lower in saturated fats and cholesterol, and have higher levels of dietary fiber, magnesium, iron and potassium, vitamins C, E and folate, carotenoids, flavonoids and other phytochemicals (Chiplonkar *et al.,* ١٩٩٩ and Fung *et al.*, ٢٠٠٤). These nutritional differences may explain some of the health advantages of those following a varied, balanced vegetarian diet.

Several commonly consumed vegetables such as cauliflower, green pea, green bean, spanish and green squash were favorable for Egyptian consumers over the years ago. Thus, the objective of this study is a trial to prepare different vegetarian diets from commonly consumed vegetables where saving the meat consumption and increasing the health benefits. The chemical, nutritional, phytochemical, sensory microbiological and characteristics were evaluated. Also, the potential applicability on home and

industrial scales to produce ready to use and ready to eat products was studied.

MATERIALS AND METHODS

Materials:

Vegetables sources such as fresh cauliflower (*Brassica oleracea*), green pea (*Pisum sativum* L.), green bean (*Phaseolus vulgaris*) and green squash (*Cucurbita pepo*). Protein sources such as faba bean (*Vicia faba* L.), chickpea (*Cicer arietinum* L.) and defatted soybean (*Glycine max* L.) flour (٤٨٪ protein and ٦٪ fat). Otherwise, tomato paste (٢٢٪ TSS), wheat flour (٧٢٪), salt and sodium bicarbonate were obtained from local supermarket at Tukh, Qaluobia, Egypt.

Fresh onion and garlic, fresh coriander, dill, parsley and traditional species mixed as [٣٠٪ pepper, ٣٠٪ cumin, ٢٠٪ relish (Boharat), ١٠٪ dry coriander and ١٠٪ dried chilies] were obtained from spices supermarket at Tukh, Qaluobia, Egypt.

Preparation of different vegetarian ingredients:

All vegetables were sorted and prepared (green leaves of cauliflower were removed then edible part was cut), (green pea was peeled), (end parties of green bean were removed then chopped in ٢ cm pieces) and (end parties of green squash was removed and chopped in ١ cm pieces). All prepared vegetables were washed and blanched for appropriate time (٥, ٤, ٥ and ٤ min, respectively) using live steam blancher then cooled down using cold water and kept until use under freezing conditions.

Peeled faba bean and unpeeled chickpea were washed and soaked in water for ١٢ hr then excessive water was drained and chickpea was peeled. Rehydrated faba bean and peeled chickpea were grounded for ٣ min using kitchen machine grounder (SIEMENS, type CNCM١١ST Germany), while defatted Soybean was rehydrated with water as (١:١,٢٥; w:w).

Additional ingredients such as potato and carrots were terminated, washed, chopped in ١ cm pieces then blanched using live steam blancher for ٧ min then immediately cooled down using cold water, peeled and homogenized to a pureed consistency with a kitchen machine. Fresh white egg was separated away from the egg yolk then cooled until use. Fresh onion and garlic were peeled, washed then chopped immediately before the manufacturing of vegetarian diets. Fresh coriander, dill and parsley were washed, teared to shreds then mixed as ٦٠, ٢٠ and ٢٠%, respectively, to prepare the green leafy vegetables mix. The internal seeds of fresh green pepper were removed and the edible part was washed and crushed.

Preparation of different vegetarian formulas:

Twelve fresh vegetarian diet formulas were prepared from the previously prepared ingredients according to formulas presented in Table ١. Two kilograms from each formula were prepared using kitchen machine mixer on speed ٢ for succession ٢ min.

Each ready-to-use vegetarian diet formula was packaged in ٢ polyethylene bags as (٠,٥ kg for chemical analysis of fresh diet and ١,٣ kg for frying process and chemical analysis of fried samples), while ٠,٢ kg was

packaged in sterilized glass jar under sterilization conditions for the microbiological analysis. The big part of prepared vegetarian diet was kept under freezing conditions homogeny of all ingredients for ١٢-١٨ hr, while other parties were subjected immediately for the chemical and microbiological analysis.

Table ١. Vegetarian formulas from different prepared fresh vegetarian diet ingredients•.

Ingredients	Fresh vegetarian diets formulas (%) percentage											
	F١	F٢	F٣	F٤	F٥	F٦	F٧	F٨	F٩	F١٠	F١١	F١٢
Vegetables												
Blanched cauliflower	٣٠	٣٠	٣٠	–	–	–	–	–	–	–	–	–
Blanched green pea	–	–	–	٣٠	٣٠	٣٠	–	–	–	–	–	–
Blanched green bean	–	–	–	–	–	–	٣٠	٣٠	٣٠	–	–	–
Blanched green squash	–	–	–	–	–	–	–	–	–	٣٠	٣٠	٣٠
Protein sources												
Soaked peeled faba bean	٢٠	–	–	٢٠	–	–	٢٠	–	–	٢٠	–	–
Peeled soaked chickpea	–	٢٠	–	–	٢٠	–	–	٢٠	–	–	٢٠	–
Rehydrated soybean flour (١:١,٢٥, w:w)	–	–	٢٠	–	–	٢٠	–	–	٢٠	–	–	٢٠
Other ingredients												
Blanched potato puree	١٥											
Wheat flour (٧٢٪)	١٠											
Blanched carrot puree	٥											
Egg white	٥											
Green leafy vegetables mix #	٥											
Fresh onion	٣											
Tomato paste (٢٢٪ TSS)	٣											
Fresh green pepper	٢											
Salt	١											
Fresh garlic	٠,٥											
Dried spices*	٠,٤											
Sodium bicarbonate	٠,١											

•: All mentioned raw materials were obtained on fresh status from the local markets at Tukh, Qaluobia, Egypt.

#: Green leafy vegetables mix (٦٠ % coriander, ٢٠٪ dill, and ٢٠ %parsley)

***: Traditional species were obtained from spices supermarket and mixed as (٣٠٪ paper, ٣٠٪ cumin, ٢٠٪ relish (Boharat), ١٠٪ dry coriander and ١٠٪ dried chilies)**.

Ready-to-eat vegetarian diets preparation:

Ready-to-eat vegetarian diets were left for thawing at room temperature then mixed with mentioned sodium bicarbonate amount immediately before frying. The vegetarian diet paste was shaped using especial frame and wide knife which designed especially for this purpose (Fig. ١). Appropriate amount of each prepared vegetarian paste was put into the frame, terminated then cut with knife in sequence for (١٠x١x٠,٨ cm) directly in sun flower oil-deep frying skillet. The vegetarian bars were fried at

١٨٠-٢٠٠°C for ٥ min in medium heated oil with constant stirring. After frying, vegetarian bars were removed using Vinaigrette handful (kitchen tool) then the excessive oil was absorbed on kitchen paper.

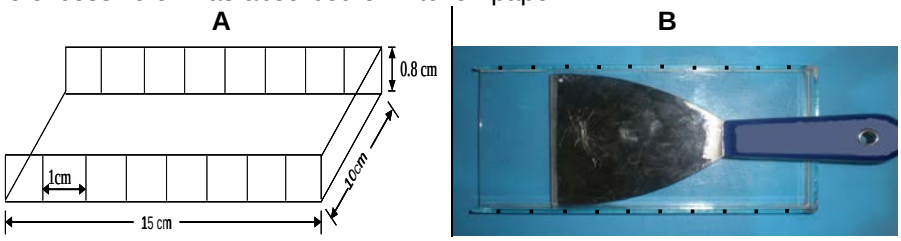

Fig. ١. Geometrical dimensions of vegetarian diets shaping frame, (A): sketch view for frame dimensions (B): live picture view including the cutting knife and frame.

Analytical methods:

Chemical composition: Both fresh and fried vegetarian diets were subjected to chemical analysis. Moisture, lipids, crude protein, crude fibre and ash contents were determined according to AOAC (٢٠٠٠). Carbohydrates content was calculated by difference according to (Merrill and Watt, ١٩٧٣). The results of the proximate analysis were calculated on dry matter.

Caloric value: the caloric value of different fresh and fried vegetarian diets was calculated basically on the crude protein, lipids and carbohydrates data according to Gebhardt and Thomas (٢٠٠٢).

Minerals content: Sodium, potassium, calcium contents were determined in both prepared fresh and fried vegetarian diets using Atomic Absorption Spectrophotometer, while magnesium, iron, copper, manganese and zinc contents were determined by flame photometry method (Baruah and Borah, ١٩٩٨). Standard colorimetric method was employed for phosphorus (Thimmaiah, ١٩٩٩).

Ascorbic acid: The ascorbic acid content, in different vegetarian diets before and after cooking, was determined by using ٢،٦-dichlorophenol-indophenol titrimetric method according to the AOAC (٢٠٠٠).

Chlorophyll a, b and carotenoids:

Ten grams fresh or fried sample were mixed with ٥٠ ml of ٨٥٪ acetone in dark bottle and left to stand for ١٥ hours at room temperature. The mixture was then filtered through glass wool into a ١٠٠ ml volumetric flask and made up to volume by ٨٥٪ acetone solution. The pigment analysis was performed immediately after the solutions were prepared using CE٥٩٩ universal Automatic Scanning Spectrophotometer at ٤٤٠, ٦٤٤ and ٦٦٢ nm using ٨٥٪ acetone as a blank (Raghuramulu *et al*., ١٩٨٣). The chlorophyll a, b and carotenoids were calculated according to the following equations:

Chlorophyll a = {(٩,٧٨٤ . $E_{٦٦٢}$ - ٠,٩٩ . $E_{٦٤٤}$) . V. ١٠٠}/m

Chlorophyll b = {(٢١,٤٦٢ . $E_{٦٤٤}$ - ٤,٦٥ . $E_{٦٦٢}$) . V. ١٠٠}/m

Carotenoids = {(٤,٦٩٥ . $E_{٤٤٠}$ - ٠,٢٦٨ . (٥,١٣٤ . $E_{٦٦٢}$ + ٢٠,٤٣٦ . $E_{٦٤٤}$) . V. ١٠٠} /m

Where:
- $E_{٦٦٢}$, $E_{٦٤٤}$, $E_{٤٤٠}$ are the absorbance
- V is the volume of the solvent
- m is the sample weight

Preparation of vegetarian formulas extract: Proper samples of fresh and fried prepared vegetarian diets were hardly mixed by a laboratory mixer with ١٠٠ ml of ٨٠% acetone (v/v). The mixes were shacked vigorously in dark bottle for ٨٠ min at ١٠٠ rpm. After centrifugation at ٣٠٠٠ *xg* for ١٥ min the supernatant was collected for total phenolic content and antioxidant activity determination. To avoid oxidation, all extracts were stored in the dark at -٢٠°C and analyses were performed within ٤٨ h (Lu *et al.,* ٢٠٠٧).

Total phenolic compounds content (TPC): The TPC of fresh prepared vegetarian diets was determined according to the Folin-Ciocalteu spectrophotometric method (Lu *et al.*, ٢٠٠٧). Briefly, ٠.٥ ml diet sample extract was mixed with ٢,٥ ml of ١٠-fold diluted Folin-Ciocalteu's phenol reagent and allowed to react for ٥ min. Then ٢ ml of ٧,٥٪ Na_2CO_3 solution was added and the final volume was made up to ١٠ ml with distilled water. After ١ h of reaction at room temperature, the absorbance at ٧٦٠ nm was measured. The measurements were compared to a standard curve of prepared gallic acid (GA) solution, and the total phenolic content was expressed as milligrams of gallic acid equivalents (GAE) per gram of dry weight (mg of GAE g^{-1} of dw).

Antioxidant activity: ١،١-Diphenyl-٢-picrylhydrazyl (DPPH) radical scavenging activity of fresh or fried vegetarian diets was determined according to the method of Gaulejac *et al.* (١٩٩٨) modified by Lu *et al.* (٢٠٠٧). Every extract from fresh diets (٠,١ ml) was added to ٢,٩ ml of ٦x١٠$^{-٥}$ µmol methanolic solution of DPPH. The absorbance at ٥١٧ nm was measured after the solution had been allowed to stand in the dark for ٦٠ min. The Trolox calibration curve was plotted as a function of the percentage of DPPH radical scavenging activity. The final results were expressed as micromoles of Trolox equivalents (TE) per gram of dry weight (*µ*mol TE g^{-1} of DW).

Microbiological examinations:

Total viable count: Ten grams of either fresh or fried vegetarian diets were homogenized with ٩٠ ml sterilize peptone water (pH ٧±٠,٢) to make a first dilution then serial dilutions were carried out. One ml from each dilutants was pour-plated with Tryptic Glucose Yeast Agar (TGYA, Biolife code No. ٤٠٢١٤٥٢) in duplicate and incubated at ٣٧ºC for ٤٨ hrs to enumerate total viable bacterial loads. Total coliform counts were enumerated using Violet Red Bile Agar (VRBA, Biolife code No. ٤٤٢١٨٥) and incubated at ٣٥ºC for ٢٤ hrs. *Escherichia coli* population were enumerated using Eosin Methylene Blue Agar (EMBA, Biolife code No. ٤٠١٤٥٠١٢) and incubated at ٣٧ºC for ٢٤ hrs. Results were expressed as CFU g^{-1} according to described method by (Kang *et al.,* ٢٠٠٣).

Moulds and yeasts: Molds and yeasts were counted according to the method described by Kottapalli & Wolf-Hall, (٢٠٠٨) using rose bengal chloramphenicol agar (RBCA, Biolife, cod. No. ٤٠١٩٩١٢ and chloramphenicol antimicrobial supplement cod. No. ٤٢١٨٤٠٠٠٣). The plates were inoculated and incubated at ٢٥°C for ٥ days. The count was then calculated as CFU g^{-1} of fresh or fried vegetarian diets.

Sensory evaluation: Sensory evaluation of ready-to-eat vegetarian diets immediately after preparation was done. Forty panelists of the staff members and students of Food Science Department and other Departments, Faculty of

Agriculture, Benha University in the age range of ١٩ and ٥٥ years were asked to evaluate the fried vegetarian bars toward (appearance, texture, taste, odor, juiciness, and overall acceptability). A ٧-point hedonic scale (٧ being like extremely, ٤ like accepted and ١ being dislike extremely) was used to evaluate ١٢ vegetarian diets formulas to select the best formula for the wide scale production. Results were subjected to analysis of variance and average of the mean values of the aforementioned attributes and their standard error were calculated. The overall acceptability was expressed as percentage of obtained score from all attributes referred to the maximum score of these attributes (Wilson *et al.,* ١٩٩٨).

Statistical analysis: The statistical analysis was carried out using ANOVA with two factors under significance level of ٠,٠٥ for the whole results using Microsoft Excel (٢٠٠٧) and Data were treated as complete randomization design according to Steel *et al.* (١٩٩٧). Multiple comparisons were carried out applying LSD.

RESULTS AND DISCUSSION

Chemical composition of fresh and fried vegetarian formulas:

Chemical composition and caloric value of ١٢ prepared vegetarian diets formulas both fresh and fried are presented in Table (٢). The moisture content of fresh prepared vegetarian formulas was ranged from a low of ٦٧,٥٢٪ in F٥ to a high of ٧٣,٥٤٪ in F١, whereas a low of ٤٢,٦٥٪ in F٤ to a high of ٥٤,٢٣٪ in F١٢ for fried diets were recorded. Significant differences (P<٠,٠٥) were found within each vegetable group and among the different groups as well as all formulas in fresh diets.

The same finding was observed after frying except the green squash group which noticed no significant difference (P>٠,٠٥) within the group. Such variation among the ١٢ formulas could be due to the different food ingredients of each formula and the cooking method used (Dashti *et al.,* ٢٠٠١). As expected, the moisture content of deep-fried vegetable diets was reduced about ٢٢,٣٨ g/١٠٠ g when calculated on the overall mean of fresh and fried diets moisture contents.

The crude protein content of the ١٢ formulas varied from ٢٩,٨٢٪ in F٤ to ٣٥,٨٨٪ in F١٢ and from ١٨,٦٠٪ in F٤ to ٢٥,٦٢٪ in F٦ for fresh and fried diets, respectively (Table ٢). Fried samples exhibit change in protein content which was around -١١,٠٧ g/١٠٠ g when calculated on the overall mean of fresh and fried diets. Significant differences (P<٠,٠٥) were found between soybean formulas and other protein sources formulas in green pea, green bean and green squash formulas, while this finding was not confirmed in cauliflower formulas. Over the four used vegetables, soybean formulas (F٣, F٦, F٩ and F١٢) exhibit the highest protein content in fresh and fried formulas. The difference in protein content on dry matter in fresh formulas may be due to using different protein sources such as faba bean, chickpea, soybean, wheat flour, white egg and others as well as preparation method used (Messina *et al.,* ٢٠٠٤). In fried sample the variation could be due to increasing the fat content which was influenced by the cooking method.

Soybean formulated with different vegetables kinds showed the highest lipids contents (٢,٦٣ –٣,٢٩٪) in fresh formulas (Table ٢). While, formulated chickpea and faba bean with cauliflower, green pea, green bean and green squash exhibit the lowest lipids contents. This result exuded significant differences between all formulas. Cooking method influenced the lipids content in all fried diets which recorded ٢١,٦٥ g/١٠٠ g more when compared with lipids content mean of fresh formulas. The vegetable kind influenced the increased oil amount which could be arranged as ٢٤,٣١>٢١,١٨>٢٠,٧٨>٢٠,٢٩% for formulated cauliflower, green bean, green pea and green squash with different protein sources, respectively. This finding could be due to the performed structure of different vegetarian diets during preparation and shaping processes which basically depends on the vegetable kind.

Data presented in Table (٢) showed that ash content ranged from ٥,٩١٪ in F٥ to ٨,٢٦٪ in F٩ for fresh formulas while ranged from ٤,٩٧٪ in F٤ to ٧,٢٧٪ in F١٢ for fried diets. Formulated different vegetables with rehydrated soybean flour exhibit the highest ash content than faba bean or chickpea formulas for each vegetable kind in fresh and fried diets. This may be due to increasing the ash content in rehydrated soybean flour compared to used faba bean or chickpea. Change rate in ash content has been observed after frying by ١,٣٩ g/١٠٠ g calculated as general mean comparing fresh to fried diets on dry matter. This is due to increasing the lipids content in the fried diets.

In the same table, the crude fiber content in the ١٢ prepared formulas was ranged from ٧,٠٦٪ in F١١ to ١٣,٦٤٪ in F٦ for fresh formulas while it was from ٥,٨٦٪ in F١٠ to ١٢,٨٦٪ in F٦ for fried diets. As previously found in ash contents formulated different vegetables with rehydrated soybean flour exhibit the highest fiber content compared to faba bean or chickpea formulas for each vegetable kind in fresh and fried diets. It seems to be similar with ash contents data in the change rate. After frying, ١,٧٦ g/١٠٠ g in ash content has been changed as general mean comparing fresh diets. This is due to increasing the lipids content in the fried diets.

The carbohydrates content of ١٢ fresh and fried vegetarian diets varied from ٤٠,٤٦% in F٩ to ٥٤,١٢٪ in F١١ for fresh formulas while it ranged from ٣٣,٥٧% in F٦ to ٤٩,٢٨٪ in F١٠ for fried diets (Table ٢). A versus trend of ash and crude fiber has been in carbohydrates content observed. Formulated vegetables with faba bean or chickpea showed highest carbohydrates content compared to rehydrated soybean flour formulas for each vegetable kind in both fresh and fried diets. As effect of increasing the lipids content ٧,٣٥ g/١٠٠ g carbohydrates content was changed.

The caloric value of food is considered an important issue allows the nutritionists to calculate the nutrition requirements. In Table ٢, the caloric value of the different vegetarian diets formulas was calculated on wet weight basically depends on the chemical composition data. The caloric value was ranged from ٨٨,٨٣ kcal/١٠٠ g in F١ to ١١٠,٨٢ kcal/١٠٠ g in F٥ in fresh formulas. While, it was ranged from ٢٠٦,٧٥ kcal/١٠٠ g in F١٠ to ٢٧٦,٤٠ kcal/١٠٠ g in F٤ for fried diets formulas. Moisture reduction and lipids

increases could increase the caloric value by ٢,٩ fold calculated basically on general mean comparing to fresh diets formulas. These results were in agreement with Gebhardt & Thomas, (٢٠٠٢).

It is highly recommended by many nutritionists the decrease of fat intake in the diet. One way to achieve this goal is through the method of cooking. For example, deep-frying can be changed to grilling which could lead to a drastic change in oil amount in the diet. However, no problem has been recorded from consumption of vegetable oils.

Minerals content of fresh and fried vegetarian formulas:

Mean of triplicates and standard error of minerals content (sodium, potassium, calcium, phosphorus, magnesium, iron, copper, manganese and zinc) in ppm for fresh and fried vegetarian diets formulas are given in Table (٣). The minerals contents were changed after frying with different reduction rates. Formulated cauliflower with different legumes showed higher sodium content which remarked with F١ than formulated green Pea where the lowest content was recoded in F٦. No significant difference (P>٠,٠٥) was found between the most of fresh formulas, this may be due to the fixed edible salt content which could be the major source of sodium element. After frying the sodium content was ranged from ٦٨١,٠٩ ppm in F٤ to ٩٧١,٩٥ ppm in F١١. Potassium content in formulated vegetables with different protein sources was ranged from a low of ٦١٣,٧٦ ppm in F١ to a high of ٧٨٦,٤١ ppm in F١١. In fried samples, potassium content was changed with different reduction rates to a low of ٣١٢,٤٧ ppm in F٣ to a high of ٧٠٨,٢٤ ppm in F١١. Significant differences (P<٠,٠٥) were found among either fresh or fried samples.

Formulated faba bean with different vegetables showed the highest calcium content in fresh prepared diets (F١, F٤, F٧ and F١٠). The same trend was also observed in fried samples except formulated green squash with the different protein sources where F١٢ recorded the highest calcium content inside this group. However, significant differences (P<٠,٠٥) were also found among both fresh and fried samples.

Phosphorus was also determined in both ready-to-use and ready-to-eat vegetarian diets and results were tabulated in Table (٣). Formulated soybean flour with different vegetables seems to be having higher phosphorus content than other formulated protein sources with same vegetables. The same finding was also shown after frying of all formulas. Also, significant differences (P<٠,٠٥) were also found in phosphorus content among either fresh or fried samples.

Magnesium content of ١٢ vegetarian diet formulas was assayed before and after frying (Table ٣). As previously shown, similar trend of calcium content was found with magnesium content in fresh prepared formulas, a trend which not confirmed after frying. No significant differences (P>٠,٠٥) were shown in magnesium content among the most of fresh and fried samples.

Iron content in different formulated vegetarian diets is given in the same Table, which was ranged from ٢,٢٧ ppm in F٢ to ٣,٥٢ ppm in F٤. While, it was ranged from ١,٨٢ ppm in F٣ to ٣,٠٣ ppm in F٥ in fried samples.

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As observed previously, in phosphorus content in both fresh and fried sample formulated soybean with different vegetable exhibit higher copper content than formulated faba bean or chickpea (Table ٣). Similar trend of this finding was also confirmed in copper content of formulated soybean with different vegetables after frying. Lowest copper content was recorded in F٢ while the highest was in F١٢ of fresh formulas. In fried samples, the copper content was generally reduced where the low amount was recorded in F١ while the highest amount was recoded in F١٢. As mentioned with calcium data, formulated faba bean with different vegetables exhibit higher manganese content than chickpea and soybean in fresh formulas (Table ٣). This result was not confirmed after frying because manganese content was changed in all fried sample with minus irregular trend. The lowest manganese content ٠,٥٢ ppm was recorded in F٢ while the highest ٠,٩٤ ppm was in F٦ in fried samples.

Zinc content was higher in formulated chickpea with green pea, green bean and green squash than formulated faba bean and soybean in fresh formulas. It was ranged from a low of ٠,٨٣ ppm in F٣ to a high of ١,٩٤ ppm in F٨. In fried diets, chickpea formulas were demonstrated the highest zinc content among all diets. zinc content was reduced in all vegetarian diets after frying by different rates (Table ٣).

Generally, some formulated vegetables with different protein sources demonstrated increases in some minerals content. This result may be basically depends on depression or increase of these minerals content in vegetable or protein sources. In addition to, the minerals content (DM) of different vegetarian diets had minus changes after frying in all prepared formulas. This may be due to the influence of frying method which could be increased the absorbed oil and consequently the lipids content increased (Table ٢). These results were in agreement with (Agte١ *et al.,* ٢٠٠٠ and Borah *et al.,* ٢٠٠٩).

Ascorbic acid, chlorophyll a, b and carotenoids content of fresh and fried vegetarian formulas:

Data in Table (٤) shows the content of vitamin C (mg/١٠٠ g) in various formulated vegetables to produce ١٢ vegetarian formulas. The average of vitamin C content of fresh formulas was ranged from ١٨,٥٥ in F٥ to ٣٠,٩١ mg/١٠٠ g in F٢. All fresh formulas demonstrated appropriate content of vitamin C which basically depends on the ingredients. Of course, the major sources of vitamin C in these diets will be the unprocessed vegetables. However, the average levels of vitamin C were not high enough in fried samples which were influenced by the cooking method. No significant difference (P>٠,٠٥) in vitamin C was found in formulated each vegetable with different protein sources and other ingredients.

Result of chlorophyll (a and b) (mg/g) for fresh and fried vegetarian diets are given in Table (٤)**.** chlorophyll (a) was ranged from ١٠,٨٤ mg/g in F٩ to ١٥,٤٥ mg/g in F٧ in fresh formulas. Significant difference (P>٠,٠٥) was found in chlorophyll (a) content among the most prepared formulas. Cooking process was influenced the chlorophyll (a) content and reduction rate was observed in all fried diets. The chlorophyll a content was ranged from ١,٤٧ mg/g in F٣ to ٣,١٦ mg/mg in F٤ and F٦ of fried samples.

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Frying the ready-to-use diets to produce ready-to-eat diets was affected the chlorophyll (a) content where ٧٩,٨٤٪ was influenced.

In the same Table, results of chlorophyll (b) (mg/g) for fresh and fried vegetarian diets are shown. Chlorophyll (b) was ranged from ٣٨,٥٨ mg/g in F٤ to ٧٤,٥٧ mg/g in F١٠ in fresh formulas. Significant difference (P<٠,٠٥) was found in chlorophyll (b) content among the most prepared formulas. Frying process influenced the chlorophyll (b) content and reduction rate was showed in all fried diets. The chlorophyll (b) content was ranged from ١٧,٦٢ mg/g in F٣ to ٢٧,٠٩ mg/g in F٦ of fried samples. Frying as cooking method influenced about ٥٥,٧٩٪ of chlorophyll (b) content when calculated basically on the general mean of fried samples data.

Table (٤) shows the carotenoids content of ١٢ different prepared formulas after and before frying. All formulas seem to be not rich in the carotenoids in either fresh or fried diets. Formulated four different vegetables with three different legumes mixed with some fixed ingredients evolved carotenoids content in ranged from ١.٣٩ mg/g in F٩ to ٢.٣٧ mg/g in F٢ for fresh formulas. While, it was ranged from ١,٢٨ mg/g in F٦ to ٢,٢٤ in F٨ for fried samples. Formulated chickpeas with different vegetables showed the highest carotenoids content for fresh and fried diets among all formulas. This finding may be due to increasing the carotenoids content in chickpeas grains. These results are in agreement with Gautama *et al.* (٢٠١٠).

Total phenolic compounds and antioxidant activity of fresh and fried vegetarian formulas:

Total phenolic compounds (TPC) and antioxidant activity of fresh and fried vegetarian diets are presented in Table (٤).

Total phenolic compounds (mg GAE/g) of fresh prepared vegetarian formulas were ranged from a low of ١٦.١٦ mg GAE/g in F١١ to a high of ٢٤,٣٠ mg GAE/g in F٣, whereas a low of ١٢,٥٥ mg GAE/g in F٥ to a high of ١٨.٨١ mg GAE/g in F٢ for fried diets were noticed. Significant differences (P<٠,٠٥) were found in TPC content among the most prepared formulas in either fresh or fried vegetarian diets.

The evolution of DPPH radical scavenging activity of various prepared vegetarian diet formulas was assayed using the DPPH free radicals before and after frying and given results in Table (٤) referred to Trolox equivalent/g (µmol TE/g). The antioxidant activity was ranged from low of ١٩,٢٣ µmol TE/g in F١١ to high of ٤٠,٠٦ µmol TE/g in F٦ for fresh formulas. The antioxidant activity increased after frying to be in range from ٥٥,٦٤ µmol TE/g in F٥ to ٧١,٦٢ µmol TE/g in F١٠ for fried samples. Significant differences (P<٠,٠٥) were found in the antioxidant activity among the most prepared formulas in either fresh or fried vegetarian diets. This difference may be basically depends on the vegetable and protein sources as well as some components which were performed during the frying process. In addition, increasing the oil content upon frying process could increase the antioxidant content of fried diets indirectly.

Microbiological quality attributes of fresh and fried vegetarian formulas:

The microbiological quality attributes of different prepared vegetarian diets on laboratory scale in both fresh and fried form calculated as CFU $g^{-١}$ are shown in Table ٥. The total viable count (TVC) of fresh vegetarian diets

was ranged from a low of ١,٤٠x١٠^{٤} CFU g$^{-١}$ in F٩ to a high of ١,٠٧x١٠^{٥} CFU g$^{-١}$ in F٤, whereas the other prepared formulas were between these numbers. Formulated faba bean with different vegetables exhibit TVC load higher than formulated chickpea or soybean. This may be due to effecting of soaking process which could increase the microbial load thereby increasing the TVC of fresh diets. However, comparing these prepared diets with some traditional Egyptian food tamia powder, (Anon, ٢٠٠٧a) and frozen tamia paste, (Anon, ٢٠٠٧b) which could be quite similar to our products, the microbiological quality of all prepared formulas seems to be in harmony with these regulation. The TVC number was highly reduced after frying the fresh diets for ٥ min in hot oil to be in range from a low of ٥,٣٥x١٠^{١} CFU g$^{-١}$ in F١١ to a high of ٩,٣٥x١٠^{٢} CFU g$^{-١}$ in F١٠. Unfortunately, no data of fried tamia or such prepared vegetarian formulas in the Egyptian Standards is regulated. coliform group was also counted in fresh prepared formulas to be in range from ٣,٢٥x١٠^{٢} CFU g$^{-١}$ in F٩ to ١,٢٥x١٠^{٣} CFU g$^{-١}$ in F١١. This may be due to the effect of washing water and the unprocessed ingredients to increase the coliform group counts. Otherwise, after frying the coliform group could not be detected, this may be due to the efficient cooking method to reduce its number under the detection limit. The same finding could be found with *E. coli* count which ranged from ١,٠٩x١٠^{٢} CFU g$^{-١}$ in F٤ to ٩,١٥x١٠^{٢} CFU g$^{-١}$ in F٩. While, in fried samples no *E. coli* colonies have been detected. Moulds and yeasts have been enumerated in either fresh or fried prepared diets. The number of fresh formulas was ranged from ٣,١٠x١٠^{٢} CFU g$^{-١}$ in F١٢ to ٣,٥٠x١٠^{١} CFU g$^{-١}$ in F٣. Also, as shown previously in coliform group and *E. coli* counts in fried samples, no moulds and yeasts have been observed.

Sensory evaluation of ready-to-eat vegetarian formulas:

Sensory evaluation of food products is an important criterion by which its consumer acceptability can be assessed (Samuel *et al.,* ٢٠٠٦). Edible vegetable is a vital component of human diet that should be eaten over the year. The sensory evaluation test on the ١٢ vegetarian diets, based on the seven-point Hedonic Scale showed that all prepared formulas recorded scores higher than ٤ in all tested parameters and more than ٧٠٪ in the overall acceptability (Table ٦). No formulated vegetable with different protein sources has been rejected by all panelists. Appearance score was ranged from a low of ٥,١٣ in F٧ and F٩ to a high of ٦,٥٣ in F٢ formulas. Appearance mean value was recorded ٢٥٪ between very good and excellent while ٧٥٪ from all samples was recorded score between good and very good. Formulated chickpea with different vegetables showed higher recorded mean value of appearance than formulated faba bean or soybean. Taste mean value was ranged from ٤,٧٥ F٩ to ٥,٧٨ in F٢ where ٧٥٪ of all formulas recorded score between good and very good while just ٢٥% recorded score between acceptable and good. As previously noticed, the chickpea formulas showed better taste than faba bean and soybean formulas for each vegetable.

The same finding was observed for odor, texture juiciness of different prepared vegetarian diets. According obtained data of appearance, taste, odor, texture and juiciness the preferably of various prepared diets could be arranged as chickpea> faba bean> soybean formulas.

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Comparing among formulated chickpea with different vegetables (F٢, F٥, F٨ and F١١), the cauliflower formulas (F٢) recorded higher value that green pea, green bean and green squash. This may be due to the effect of cauliflower sensory characteristics which was highly familiar by most panelists. In addition, eating of green pea, green bean and green squash was highly habitual with tomato sauces. This is probably the reason for their high acceptability by the consumers in the sensory evaluation. The given overall acceptability by most panelists confirmed that chickpea formulas could be the best prepared vegetarian diets. The highest mean value was recoded for F٢ followed by F١١ and F٥ then F٨. Significant differences (P<٠,٠٥) in the overall acceptability mean value were found between chickpeas formulas and other formulas. No significant differences (P>٠,٠٥) was recorded between faba bean and soybean formulas except green Squash formulas significant differences (P>٠,٠٥) between them was found. The vegetables kind affected the mean values of sensory evaluation for different formulas when compared statistically. Significant differences (P<٠,٠٥) were found among chickpea formulas with different vegetables kind which has been generally accepted as edible vegetable in this community. This finding could be helpful to select the highly acceptable formulas for food plant application. Therefore, cauliflower, green pea, green bean and green squash are hereby recommended as edible vegetables, particularly during the summer season when other conventional vegetables are scarce, expensive or not available.

Conclusions

With the growing urbanization, changes in food habits should be occurred. The present results of prepared vegetarian diets could provide appropriate status of these healthy meals. The high antioxidant activity, phyto-pigments and vitamins could maximize the healthy benefits. Moreover, the rich content of macro- and micro-nutrients which will meet a big part of consumer caloric requirements. In addition, the highly consumer acceptability of prepared vegetarian diets could be an encourage motive for plant scale applications. Therefore, it is now imperative that such Egyptian standards for regulate ready-to-use and ready-to-eat vegetarian diets could be required. Many studies about formulate different vegetables with different protein sources to produce functional meals as well as microbiological quality and shelf-life stability should be investigated.

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تقييم خلطات غذائية نباتية مختلفة

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قسم علوم الأغذية، كلية الزراعة، جامعة بنها، مصر

فى الأونة الأخيرة زاد الإقبال على تناول الأغذية النباتية لما لها من فوائد صحية هامة. وفي هذه الدراسة ، تم إعداد اثني عشر خلطة غذائية نباتية مختلفة باستخدام أنواع من الخضروات مثل: القنبيط، البازلاء الخضراء ، والفاصوليا الخضراء والكوسة الخضراء مع مصادر مختلفة من البروتين مثل: الفول البلدى المقشور والحمص المقشور ودقيق فول الصويا منزوع الدهن بالإضافة إلى بعض المكونات الغذائية الأخرى (بطاطس – دقيق القمح ٧٢% - جزر – بياض بيض – خضروات ورقية – بصل – مركز طماطم – فلفل أخضر – ثوم – ملح – توابل جافة – بيكربونات صوديوم). وقد تم تقييم الخلطات الغذائية النباتية الاثني عشر الجاهزة للإستخدام والجاهزة للتناول من حيث التركيب الكيماوى، القيمة السعرية (الحرارية)، ومحتواها من المعادن، وفيتامين ج، والكلوروفيل (أ، ب) والكاروتينات والمواد الفينولية الكلية ونشاطها كمضادات أكسدة. وبالإضافة إلى ذلك ، تم تقدير الحمل الميكروبى مثل: العد الكلى، وبكتريا القولون، الإيشيرشيا كولاى والفطريات والخمائر. وعلاوة على ذلك، كما تم إجراء التقييم الحسى للخلطات المعدة (من حيث: المظهر، القوام ، المذاق، الرائحة، العصيرية والقابلية العامة) بواسطة ٤٠ فرد (أعمار مختلفة ١٨-٥٥ سنة).

وأظهرت النتائج أن محتوى الخلطات الطازجة المعدة من الرطوبة، البروتين الخام، الدهون، الرماد، الألياف الخام والكربوهيدرات تراوحت بين ٦٧,٥٢ إلى ٧٣,٥٤ ، ٢٩,٨٢ إلى ٣٥,٨٨، ٢,٦٣ إلى ٣,٢٩، ٥,٩١ إلى ٨,٢٦، ٧,٠٦ إلى ١٣,٦٤ و ٤٠,٤٦ إلى ٥٤,١٢٪ على التوالي . بينما كان محتوى الخلطات المقلية كالتالى: الرطوبة من ٤٢,٥٦ إلى ٥٤,٢٣٪ والدهون من ١٩,٧٢ إلى ٢٦,٧٦٪. ، فى حين تراوح محتواها من البروتين الخام والرماد والألياف الخام والكربوهيدرات من ١٨,٦٠ إلى ٢٥,٦٢ ، ٤,٩٧ إلى ٧,٢٧ ، ٥,٨٦ إلى ١٢,٨٦ و ٣٣,٥٧ إلى ٤٩,٢٨٪ ، على التوالي. وكانت جميع الخلطات الغذائية النباتية غنية في محتواها من المعادن. أثرت عملية القلي بشكل كبير على محتوى الخلطات الغذائية النباتية من: فيتامين (ج) ، والكلوروفيل أ، ب والكاروتينات. وكان معدل الفقد فيها ٩١,٠٢ ، ٧٩,٨٤ ، ٥٥,٧٩ ، ١٥,١٤٪ على التوالى. وكان هناك فرق معنوى في إجمالي محتوى المركبات الفينولية ونشاطها كمضادات أكسدة في الوجبات النباتية سواء كانت طازجة أو مقلية. وبالإضافة إلى ذلك ، أظهرت نتائج التقييم الحسى أن الخلطات الغذائية النباتية المعدة باستخدام الحمص كانت أفضل الخلطات بوجه عام. وكان هناك فرق معنوى بين الخلطات المعدة باستخدام الحمص كمصدر للبروتين وباقى الخلطات المعدة باستخدام الفول البلدى أو دقيق فول الصويا وإن كانت جميع الخلطات مقبولة حسيا. وكان الحمل الميكروبى للخلطات المقلية قليلا جدا مقارنة بالخلطات الطازجة. بالإضافة إلى ذلك لم يتم العثور على بكتريا القولون، الأيشيرشيا كولاي والفطريات والخمائر فى الخلطات المقلية. وأخيرا من خلال النتائج المتحصل عليها فإنه يمكن إنتاج خلطات غذائية نباتية صحية باستخدام الخضروات المختلفة ومصادر مختلفة من البروتين وإعدادها على نطاق تجارى مما يفتح رؤى جديدة لتحسين الوجبات التقليدية والصحة العامة للمستهلك.

قام بتحكيم البحث

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Table (١): Chemical composition and caloric value of different fresh and fried prepared vegetarian formulas.

Vegetable kind	Protein source	Formula No.	Chemical composition (%)												Caloric value kcal/١٠٠ g wet weight	
			Moisture content		Crude protein*		Lipids*		Ash*		Crude fiber*		Carbohydrates*			
			Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried
Cauliflower	Faba bean	F١	a ٧٣,٥٤ ±٠,١٠	cd ٤٨,٣١ ±٠,٢٤	c ٣٠,٥٧ ±٠,٧٠	de ١٩,٠٤ ±٠,٥٦	cde ١,٣٣ ±٠.١٣	ab ٢٥,٨٧ ±٠,٣٢	c ٧,٤٢ ±٠,٠٢	ef ٥,٢٤ ±٠,٠٧	cd ٨,٧٧ ±٠,١٩	de ٦,٣٤ ±٠,٠٩	ab ٥١,٩١ ±٠,٧٠	bcde ٤٣,٥١ ±٠,٣١	e ٨٨,٨٣ ±٠,٢٨	cd ٢٤٦,٩٦ ±٢,١٥
	Chickpea	F٢	de ٧١,٥٤ ±٠,٠٨	e ٤٦,٧٣ ±٠,٤٣	bc ٣٢,٣١ ±٠,٦٨	de ١٩,٤٥ ±٠,٦٩	cd ١,٤٣ ±٠,٠٧	a ٢٦,٣٥ ±٠,٨٤	d ٦,٥٥ ±٠,٣٤	ef ٥,٢٩ ±٠,٠٤	cde ٨,٢٤ ±٠,٢٢	de ٦,٤١ ±٠,١٢	ab ٥١,٤٧ ±٠,٩٤	cdef ٤٢,٥٠ ±٠,٥٨	b ٩٧,٣١ ±٠,٢٧	bc ٢٥٥,٦٣ ±٤,١٨
	Soybean	F٣	a ٧٣,٥٣ ±٠,١٣	f ٤٤,٦٤ ±٠,١٥	ab ٣٤,٧٢ ±٠,٣٢	cd ٢٠,٦٨ ±٠,٥٩	a ٣,٢٩ ±٠,٢٣	a ٢٦,٧٦ ±٠,٨٧	a ٨,٢٠ ±٠,٠٦	de ٥,٦٩ ±٠,٠٣	c ٩,١١ ±٠,٥٢	de ٦,٤٧ ±٠,٤٢	c ٤٤.٦٨ ±٠,٥٢	de ٤٠,٤٠ ±٠,٧٣	de ٩٠,٥٤ ±٠,٣٤	ab ٢٦٥,٩١ ±٢,٧٥
Green Pea	Faba bean	F٤	f ٧٠,٠٧ ±٠,٠٣	f ٤٢,٦٥ ±٠,٥٣	c ٢٩,٨٢ ±١,٠٢	e ١٨,٦٠ ±٠,٢٣	c ١,٧٥ ±٠,١٣	a ٢٦,٣٦ ±٠,٨٨	d ٦,٦١ ±٠,٠٤	f ٤,٩٧ ±٠,١٥	cde ٨,١١ ±٠,٤٢	c ٦,١٧ ±٠,٢٠	ab ٥٣,٧١ ±٠,٩٧	bcd ٤٣,٩٠ ±٠,٨٧	a ١٠٢,٨٢ ±٠,٢٠	a ٢٧٦,٤٠ ±٣,٥٦
	Chickpea	F٥	h ٦٧,٥٢ ±٠,٠٦	de ٤٦,٨٤ ±٠,٦٩	c ٣٠,٩٣ ±٠,٩٥	bc ٢٢,٦٢ ±٠,٨٩	cd ١.٣٩ ±٠,١٣	efg ٢٠,٤٧ ±٠,٩٠	e ٥,٩١ ±٠,٠٠	ef ٥,٢٣ ±٠,١٥	c ٨,٩٧ ±٠,٥٢	cd ٧,٦٦ ±٠,٥٨	ab ٥٢,٨٠ ±٠,٤٧	bc ٤٤,٠٢ ±١,٢٧	a ١١٠,٨٢ ±٠,٦٨	de ٢٣٦,٨٢ ±٤,٩٤
	Soybean	F٦	g ٦٩.٨٠ ±٠,١١	b ٤٩,٢٢ ±١,١٢	a ٣٥,٧٤ ±١,٥٠	a ٢٥,٦٢ ±١,٣٧	b ٢,٦٣ ±٠,٣٢	cdefg ٢١,٢٨ ±١,٠٧	c ٧,٣٦ ±٠,٠٣	b ٦,٦٧ ±٠,٢٣	a ١٣,٦٤ ±١,٠٤	a ١٢,٨٦ ±١,٢٤	d ٤٠,٦٣ ±٢,١٠	g ٣٣,٥٧ ±١,٤٨	b ٩٨,٠١ ±١,١٣	fg ٢١٥,٢٩ ±٢,٠٣
Green Bean	Faba bean	F٧	b ٧٢,٣٧ ±٠,١٦	cd ٤٨,٧٧ ±٠,٦١	c ٣٠,٥٨ ±١,٠٥	cde ٢٠,٨٧ ±١,٥٩	cde ١,٣٠ ±٠,١٧	ab ٢٥,٧٣ ±١,٣٤	c ٧,٢٩ ±٠,٠٥	de ٥,٤٩ ±٠,١٠	b ١١,٢٨ ±٠,٢٤	c ٨,٦٨ ±٠,٢٠	b ٤٩,٥٥ ±١,٢٠	f ٣٩,٢٣ ±٠,٨١	de ٩٠,١٨ ±٠,٧٥	d ٢٣٩,٣٠ ±٢,٤٥
	Chickpea	F٨	e ٧١,٣٤ ±٠,٠٤	bc ٤٩,٩٧ ±٠,٥٩	c ٣٠,٣٣ ±١,٦٦	cde ٢٠,١٦ ±٠,٥٨	cd ١,٢٨ ±٠,٠٣	bcd ٢٣,٢٢ ±٠,٦٥	c ٧,٢٢ ±٠,١٨	cd ٥,٨٧ ±٠,٠٧	b ١٠,٥٩ ±٠,٢٨	c ٨,٨٠ ±٠,٢١	b ٥٠,٥٨ ±٢,١٠	cde ٤١,٩٥ ±٠,٦٠	c ٩٤,٣٤ ±٠,٥٣	ef ٢٢٦,٢٧ ±١,٣٣
	Soybean	F٩	cd ٧١,٨٧ ±٠,١٠	b ٥٠,٩٥ ±٠,٨٨	a ٣٥,٤٠ ±٠,٩٩	b ٢٢,٨٩ ±٠,٦٣	ab ٢,٩٣ ±٠,١٨	fg ٢٠,١١ ±١,٢٠	a ٨,٢٦ ±٠,٠٤	bc ٦,٤٢ ±٠,٤٧	a ١٢.٩٥ ±٠,٥٧	b ١٠,٤٧ ±٠,١٣	d ٤٠,٤٦ ±١,١١	ef ٤٠,١١ ±١,٧١	d ٩١,٥١ ±٠,٦٥	g ٢١٠,١٢ ±٦,٠٩
Green Squash	Faba bean	F١٠	a ٧٣,٥٢ ±٠,٠٤	a ٥٣,٧٢ ±١,٢٩	c ٣٠,٢٧ ±١,٠٩	d ١٩,٤٤ ±٠,٧٩	e ٠,٨٦ ±٠,٠٩	g ١٩,٧٢ ±١,١٤	c ٧,٣٣ ±٠,٠٦	de ٥,٧٠ ±٠,٢٤	de ٧,٥٢ ±٠,١٦	f ٥,٨٦ ±٠,٣٤	a ٥٤,٠٢ ±١,١٤	a ٤٩,٢٨ ±١,٨٩	de ٨٩,٦٤ ±٠,٢٨	g ٢٠٦,٧٥ ±٨,٦٩
	Chickpea	F١١	e ٧١,٤٩ ±٠,٠٤	a ٥٣,٥١ ±٠,١٩	c ٣١,٠٦ ±٠,٢٩	cde ٢٠,٦٣ ±٠,٨٦	de ١,١٢ ±٠,١١	de ٢٠,٦٦ ±٠,٦٨	d ٦,٦٤ ±٠,١٠	cd ٥,٩٧ ±٠,٠٩	e ٧,٠٦ ±٠,١٩	ef ٦,١١ ±٠,١٠	a ٥٤,١٢ ±٠,٤٥	ab ٤٦,٦٣ ±١,٥٣	b ٩٨,٢٠ ±٠,٢٣	g ٢٠٨,٨٧ ±٢,٢٦
	Soybean	F١٢	e ٧١,٥٣ ±٠,٢٦	a ٥٤,٢٣ ±٠,٥٤	a ٣٥,٨٨ ±٠,٦١	ab ٢٤,٩٢ ±٠,٩٣	ab ٣,٠٠ ±٠,٢٥	ab ٢٥,٤٧ ±٠,٨٧	b ٧,٨٣ ±٠,٠٦	a ٧,٢٧ ±٠,٢٥	cd ٨,٦٣ ±٠,٣٨	c ٧,٨٩ ±٠,٥٤	c ٤٤,٦٦ ±٠,٦٢	g ٣٤,٤٥ ±١,٣٨	b ٩٧,٩٥ ±١,٥٨	g ٢١١,٧٩ ±٣,٩٧
LSD (P<٠,٠٥)			٠,٣٣	٢,٠٣	٢,٨٩	٢,٥٨	٠,٥١	٢,٧٢	٠,٥١	٢,٧٢	١,٣٥	١,٣٧	٣,٣٩	٣,٥٠	٢,٠٥	١٢,٢٧

***: values were calculated on dry weight basis.**

Means with the same latter in the same column are not significant different (*P*>٠,٠٥)

Table (٣): Minerals content of different fresh and fried prepared vegetarian formulas calculated on dry matter.

Vegetable kind	Protein source	Formula No.	Minerals content (ppm)																	
			Sodium		Potassium		Calcium		Phosphorus		Magnesium		Iron		Copper		Manganese		Zinc	
			Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried
Cauliflower	Faba bean	F١	a ١١١٠,٥٢ ±٣٨,٦٩	ab ٧٨٤,١٣ ±١٨,١٣	bcd ٦١٣,٧٦ ±١٥,٨٦	def ٤٣٣,٣٧ ±١٠,٠٢	abc ٩١,٨١ ±٢,٣٧	ab ٦٤,٨٣ ±١,٥٠	de ١١٦,٢٩ ±٣,٠٠	de ٨٢,١١ ±١,٩٠	a ١٠١,٢٦ ±٢,٦٢	bc ٧١,٥٠ ±١,٦٥	bcd ٢,٨٨ ±٠,٠٧	de ٢,٠٣ ±٠,٠٥	c ٠,٣٩ ±٠,٠١	d ٠,٢٧ ±٠,٠١	abcd ٠,٩٦ ±٠,٠٢	bc ٠,٦٨ ±٠,٠٢	def ١,٢١ ±٠,٠٣	ef ٠,٨٥ ±٠,٠٢
	Chickpea	F٢	ab ١٠٧٠,٧٨ ±٢٨,٧٢	abc ٨٦٨,٠١ ±٢٠,٦٠	de ٥١٩,٨٠ ±١٣. ٩٤	ef ٤٢١,٣٧ ±٩,٧١	h ٣١,٤٥ ±٠,٨٤	d ٢٥,٤٩ ±١,١٩	f ٧٦,١٩ ±٢,٠٤	e ٦١,٧٧ ±٢,٨٩	c ٦٧,٠٥ ±١,٨٠	c ٥٤,٣٦ ±٢,٥٤	d ٢,٢٧ ±٠,٠٦	e ١,٨٤ ±٠,٠٩	c ٠,٣٥ ±٠,٠١	d ٠,٢٨ ±٠,٠١	e ٠,٦٥ ±٠,٠٢	c ٠,٥٢ ±٠,٠٢	efg ١,٠٥ ±٠,٠٣	ef ٠,٨٥ ±٠,٠٤
	Soybean	F٣	ab ١٠٤٦,٨٩ ±٣٣,٠٧	bc ٧٢٥,٢٩ ±١٥,٧٨	e ٤٥١,٠٢ ±١٤,٢٥	f ٣١٢,٤٧ ±٦,٨٠	def ٦٣,٩٧ ±٢,٠٢	c ٤٤,٣٢ ±٠,٩٦	b ٢٢٣,٧١ ±٥,٠٧	c ١٥٤,٩٩ ±٣,٣٧	bc ٨٠,٩٨ ±٢,٥٦	c ٥٦,١٠ ±١,٢٢	cd ٢,٦٣ ±٠,٠٨	e ١,٨٢ ±٠,٠٤	b ١,١٦ ±٠,٠٤	c ٠,٨١ ±٠,٠٢	de ٠,٧٨ ±٠,٠٢	c ٠,٥٤ ±٠,٠١	g ٠,٨٣ ±٠,٠٣	f ٠,٥٨ ±٠,٠١
Green Pea	Faba bean	F٤	ab ٩٠٦,٠٥ ±٣٧,٤٣	c ٦٨١,٠٩ ±٢٢,٧٣	abc ٧١١,٤٣ ±٢٢,٩٥	bcde ٥٣٤,٧٩ ±٢١,٤٠	a ٩٧,٢٩ ±٣,٢٤	a ٧٣,١٣ ±٢,٦٦	c ١٦٤,٥٤ ±٤,٢٥	cd ١٢٣,٦٨ ±٩,٥٨	a ١١٤,١١ ±٨,٤٩	ab ٨٥,٧٨ ±٢,٦٤	a ٣,٥٢ ±٠,٢٦	abcd ٢,٦٤ ±٠,٢٠	c ٠,٤٩ ±٠,٠٤	d ٠,٣٧ ±٠,٠٣	a ١,١٤ ±٠,٠٩	ab ٠,٨٦ ±٠,٠٧	ab ١,٨١ ±٠,١٣	bc ١,٣٦ ±٠,١١
	Chickpea	F٥	ab ٩٩٢,٥٣ ±٤٨,٤٧	abc ٨٨٢,١٦ ±٣٣,٨١	abc ٧١٩,٦٣ ±٢١,٢٥	ab ٦٣٩,٦١ ±٢٨,٠١	fg ٤٩,٢٩ ±٢,٢٠	c ٤٣,٨١ ±١,٦٦	cd ١٤٣,٩٣ ±٣,٢٥	cd ١٢٧,٩٣ ±١٣,٦٠	a ٩٦,٦٧ ±٨,٢٣	ab ٨٥,٩٢ ±٣,١٤	ab ٣,٤١ ±٠,٢٩	ab ٣,٠٣ ±٠,٣٢	c ٠,٥٢ ±٠,٠٤	d ٠,٤٦ ±٠,٠٥	abc ٠,٩٩ ±٠,٠٨	ab ٠,٨٨ ±٠,٠٩	a ١,٩١ ±٠,١٦	a ١,٧٠ ±٠,١٨
	Soybean	F٦	b ٨٨٥,٣٧ ±٤٠,١٦	abc ٨٠٥,٣٠ ±٣٢,٥٥	cde ٥٨٤,٦٥ ±١٦,٥٢	bcde ٥٣١,٧٨ ±١٩,٣١	cd ٧٨,٣١ ±٣,٥٥	a ٧١,٢٢ ±٢,٥٣	a ٢٨٢,٤٦ ±٦,٨١	a ٢٥٦,٩٢ ±١٩,٩٦	a ١٠٢,٣٣ ±٤,٦٤	ab ٩٣,٠٨ ±٣,٢٣	abc ٣,٤٨ ±٠,١٦	a ٣,١٦ ±٠,٢٥	ab ١,٣٢ ±٠,٠٦	ab ١,٢٠ ±٠,٠٩	abc ١,٠٤ ±٠,٠٥	a ٠,٩٤ ±٠,٠٧	bcd ١,٥١ ±٠,٠٧	bc ١,٣٧ ±٠,١١
Green Bean	Faba bean	F٧	ab ٩٠٢,٦٥ ±٣٣,٥٠	c ٦٧٩,٩٠ ±٢٥,٤٢	abc ٦٨٧,٢٠ ±٢٣,٥٧	bcde ٥١٧,٦٢ ±١٩,٨١	a ١٠٤,٠٩ ±٥,٦٣	a ٧٨,٤٠ ±٣,٥٤	de ١٢١,٦٤ ±٢,٢٥	de ٩١,٦٢ ±٨,٨٢	a ١٠٨,٧٩ ±٨,٠٦	ab ٨١,٩٤ ±١,٨٨	ab ٣,٢٠ ±٠,٣٠	bcde ٢,٤١ ±٠,٢٣	c ٠,٤٣ ±٠,٠٤	d ٠,٣٢ ±٠,٠٣	abc ١,٠٢ ±٠,٠٩	ab ٠,٧٧ ±٠,٠٧	abc ١,٦٨ ±٠,١٦	bcd ١,٢٦ ±٠,١٢
	Chickpea	F٨	ab ١٠٨١,٨٢ ٣٦,٣٢	abc ٨٨١,٨٤ ±٢٦,٦٧	ab ٧٥٨,٦٨ ±٢٠,٥٤	ab ٦١٨,٤٤ ±٢٣,٧٧	ef ٦٢,٣٢ ±٢,٩٧	bc ٥٠,٨٠ ±١,٤٢	ef ١٠٦,٤٥ ±٢,٤٩	de ٨٦,٧٧ ±٧,٥٤	ab ٩٩,٥٤ ±٧,٩٤	ab ٨١,١٤ ±٢,٠٦	ab ٣,٣٦ ±٠,٢٧	abc ٢,٧٤ ±٠,٢٤	c ٠,٥٠ ±٠,٠٤	d ٠,٤١ ±٠,٠٤	abcd ٠,٩٤ ±٠,٠٧	ab ٠,٧٦ ±٠,٠٧	a ١,٩٤ ±٠,١٥	ab ١,٥٨ ±٠,١٤
	Soybean	F٩	ab ٩٤٢,٧٤ ±٢٨,٥٤	bc ٧٣٨,١١ ±٣١,٩٦	cd ٦٠٠,٠٢ ±١٧,٢٦	cde ٤٦٩,٧٨ ±١٨,٥٣	ab ٩٠,٩٠ ±٤,٦٤	a ٧١,١٧ ±٣,٨٧	ab ٢٥٦,٣٨ ±٥,٩٢	b ٢٠٠,٧٣ ±١٥,٠١	a ١٠٣,٨٤ ±٦,٤٥	ab ٨١,٣٠ ±٣,١٣	abc ٣,٣٨ ±٠,٢١	abcd ٢,٦٥ ±٠,٣٣	a ١,٣٤ ±٠,٠٨	b ١,٠٥ ±٠,١٣	abc ٠,٩٨ ±٠,٠٦	ab ٠,٧٦ ±٠,١٠	cd ١,٤٨ ±٠,٠٩	cde ١,١٦ ±٠,١٤
Green Squash	Faba bean	F١٠	ab ٩٣٣,٨٣ ±٢٨,٧٢	bc ٧٢٨,١٥ ±٢٤,٠٢	ab ٧٣٦,٧٢ ±١٤,٧٧	abcde ٥٧٤,٤٦ ±١٤,٧٣	ab ٩٤,١٦ ±١,٨٩	a ٧٣,٤٢ ±٢,٤٤	de ١٢٢,٣٥ ±٢,٤٥	de ٩٥,٤٠ ±٥,٧٧	a ١١٠,٩٠ ±٢,٢٢	ab ٨٦,٤٧ ±٢,٢٣	abc ٢,٩٤ ±٠,٠٦	cde ٢,٢٩ ±٠,١٤	c ٠,٤٥ ±٠,٠١	d ٠,٣٥ ±٠,٠٢	abc ٠,٩٩ ±٠,٠٢	ab ٠,٧٧ ±٠,٠٥	def ١,٢٤ ±٠,٠٢	de ٠,٩٧ ±٠,٠٦
	Chickpea	F١١	a ١٠٧٩,٢٢ ±٤٣,٣٠	a ٩٧١,٩٥ ±٣٦,٢١	a ٧٨٦,٤١ ±١٧,٩٨	a ٧٠٨,٢٤ ±٣٢,٨٢	gh ٤٦,٤٨ ±١,٠٢	cd ٤١,٨٦ ±٣,٧١	ef ١٠٢,٠٩ ±٣,٨٣	de ٩١,٩٤ ±٨,١٦	ab ٩٧,٣٥ ±٥,٤٢	ab ٨٧,٦٧ ±٣,٧٨	abc ٢,٩٢ ±٠,٢٥	abcd ٢,٦٣ ±٠,٢٣	c ٠,٥٠ ±٠,٠٤	d ٠,٤٥ ±٠,٠٤	cd ٠,٨٧ ±٠,٠٧	ab ٠,٧٨ ±٠,٠٧	cde ١,٣٦ ±٠,١٢	cd ١,٢٣ ±٠,١١
	Soybean	F١٢	ab ٩٧٨,٣٩ ±٣٥,٣٧	ab ٩١٤,٩٥ ±٣٣,٦٣	bcd ٦٤٩,٥٧ ±١٣,٣٢	abc ٦٠٧,٤٥ ±٢٢,٠٨	bc ٨٠,٠٩ ±٢,٨١	a ٧٤,٨٩ ±٢,١٢	a ٢٦٢,٦٧ ±٥,٦٠	a ٢٤٥,٦٤ ±١٣,١٩	a ١٠٦,٠٢ ±٦,٣٣	a ٩٩,١٤ ±٤,٤٠	abc ٣,١٣ ±٠,٣٠	abc ٢,٩٢ ±٠,٣٩	a ١,٣٩ ±٠,١٤	a ١,٣٠ ±٠,١٨	abcd ٠,٩٥ ±٠,٠٩	ab ٠,٨٩ ±٠,١٢	fg ١,٠٢ ±٠,١٠	de ٠,٩٥ ±٠,١٣
LSD (P<٠,٠٥)			١٩٢,٢٢	٢٠٨,١٠	١٣٥,٤٨	١٤٤,١٦	١٥,١٤	١٦,٤٢	٣٤,٩٤	٤٣,٤٦	٢٠,٠٦	٢١,٨٥	٠,٦٣	٠,٦٩	٠,١٧	٠,٢١	٠,١٩	٠,٢١	٠,٣١	٠,٣٢

Means with the same latter in the same column are not significant different (*P*>٠,٠٥)

Table ٤. Ascorbic acid, chlorophyll a, b and carotenoids, total phenolic compounds and antioxidant activity of different fresh and fried prepared vegetarian formulas.

Veget-able kind	Protein source	Form-ula No.	Vitamin C (mg/١٠٠ g)		Chlorophyll (mg/g)				Carotenoids (mg/g)		Total phenolic compounds content (mg GAE/g)		Antioxidant activity (µmol TE/g)	
					a		b							
			Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried
Cauliflower	Faba bean	F١	bcd ٢٧,٢٨ ±١,٣٩	de ١,٣٦ ±٠,٢٧	ab ١٤,٢٩ ±٠,٣٤	c ٢,٢٨ ±٠,٠٧	d ٤٦,٩٣ ±٠,٩٨	e ١٩,٤٩ ±٠,٥٠	a ٢,٢٣ ±٠,٢٧	de ١,٧٥ ±٠,١٠	c ٢٠,٤٠ ±٠,٢٤	bc ١٧,٩٣ ±٠,٣٠	bcd ٣٣,٣٥ ±٤,٧٩	b ٦٥,٨٧ ±٠,٨٠
	Chickpea	F٢	b ٣٠,٩١ ±٣,٦٨	abc ٢,٤٨ ±٠,٢٧	bc ١٣,٢٧ ±٠,٢٦	d ١,٥٠ ±٠,١٦	de ٤٤,٢٠ ±٠,٤٦	e ١٩,٩٥ ±٠,١٩	a ٢,٣٧ ±٠,١٣	bcd ١,٨٩ ±٠,٠٥	ab ٢٣,٢٥ ±٠,٥٨	ab ١٨,٨١ ±٠,٣١	e ٢٥,٥٤ ±٣,١٤	bc ٦٣,٣١ ±١,٢٠
	Soybean	F٣	bc ٢٨,٩٣ ±١,٥٣	abc ٢,٥٣ ±٠,٤٩	bc ١٣,٠٠ ±٠,٢١	d ١,٤٧ ±٠,٠٧	de ٤٤,٦٤ ±٠,٤٩	f ١٧,٦٢ ±٠,٢٩	a ٢,٣١ ±٠,٢٥	de ١,٦٧ ±٠,٠٦	a ٢٤,٣٠ ±٠,٦٧	def ١٦,٨٣ ±٠,٢٩	d ٣٠,٥١ ±٠,٥٣	cd ٦٠,٠٧ ±٠,٣٥
Green Pea	Faba bean	F٤	fg ٢١,٠٣ ±١,٣١	e ١,٢٣ ±٠,٢٥	c ١٢,٥٥ ±٠,١٦	a ٣,١٦ ±٠,٠٨	f ٣٨,٥٨ ±٠,٩٨	d ٢٣,٣٨ ±٠,٧١	a ١,٧٥ ±٠,٣٦	e ١,٦٠ ±٠,١٠	efg ١٦,٣٦ ±٠,٢٨	g ١٤,٥٣ ±٠,٤٤	fg ٢٠,١٨ ±٣,٦٨	de ٥٨,٩٠ ±١,٢٢
	Chickpea	F٥	g ١٨,٥٥ ±٢,١٦	cde ٢,١٤ ±٠,١١b	c ١٢,٩٥ ±١,٠٤	ab ٢,٧٥ ±٠,٢٠	ef ٤١,٣٦ ±٠,٤٦	cd ٢٤,٠٧ ±٠,٦٣	a ٢,٢٢ ±٠,٥٦	abc ٢,٠٦ ±٠,١٠	de ١٧,٥٨ ±١,٢٠	h ١٢,٥٥ ±٠,٢٦	e ٢٤,٦٤ ±٢,١٨	e ٥٥,٦٤ ±١,١١
	Soybean	F٦	def ٢٣,٥١ ±٢,٣٢	de ١,٣٣ ±٠,٢٧	a ١٥,١٢ ±٠,٢٨	a ٣,١٦ ±٠,١٨	d ٤٥,٨٣ ±٠,٤٩	a ٢٧,٠٩ ±٠,٤٢	a ١,٩٠ ±٠,٢٤	cd ١,٨٨ ±٠,٠٥	bc ٢١,٣٥ ±٠,٣٣	g ١٤,٩٩ ±٠,٤٣	a ٤٠,٠٦ ±٥,٦٩	de ٥٨,٢٧ ±٠,٩٥
Green Bean	Faba bean	F٧	bcde ٢٦,٤٨ ±٢,٩١	bcd ٢,٢٨ ±٠,٣٩	a ١٥,١٢ ±٠,٢٨	c ٢,٢٣ ±٠,١٧	b ٦١,٥٠ ±٠,٦٣	d ٢٣,٠٩ ±٠,٣٧	a ١,٩٩ ±٠,٣٥	de ١,٨٠ ±٠,٠٥	ab ٢٢,٥١ ±١,٢٠	cd ١٧,٢٧ ±٠,٢١	ab ٣٦,٠٥ ±٨,٧٦	b ٦٢,٥٦ ±١,٠٢
	Chickpea	F٨	a ٣٦,٩٧ ±٣,٧٩	abc ٢,٨١ ±٠,٣٥	a ١٥,٤٥ ±٠,٢٥	ab ٢,٨٤ ±٠,٢٣	c ٥٧,٤٠ ±٠,٦٢	bc ٢٥,٣٩ ±٠,٣٧	a ٢,٨١ ±٠,٣٠	a ٢,٢٤ ±٠,٠٥	e ١٦,٨١ ±٠,٢٧	cd ١٧,٧٥ ±٠,٠٥	bc ٣٥,٥٠ ±٣,٨٢	b ٦٤,٢٦ ±٠,٦٧
	Soybean	F٩	bcde ٢٧,٠٧ ±٢,٤٥	abc ٢,٥٤ ±٠,٤٥	d ١٠,٨٤ ±٠,٣٨	b ٢,٦٨ ±٠,١٥	a ٧٤,٥٦ ±٠,٥٥	d ٢٣,٥٢ ±٠,٣٥	a ١,٩٦ ±٠,٤٢	f ١,٣٦ ±٠,٠٨	d ١٨,٠٦ ±١,١٦	ef ١٦,٥٢ ±٠,١٤	bcd ٣٣,٥٧ ±١,٢٢	ab ٦٨,٣٥ ±٢,١٧
Green Squash	Faba bean	F١٠	ef ٢٢,٦٨ ±٢,٦٥	abc ٣,١١ ±٠,٢٥	a ١٤,٨٤ ±٠,٥٦	bc ٢,٥٠ ±٠,١٤	a ٧٤,٥٧ ±٣,١٤	d ٢٣,٦٧ ±٠,٧٩	a ٢,١٤ ±٠,٦٩	a ٢,١٢ ±٠,١٠	a ١٩,٢٣ ±٠,٣٧	efg ١٦,٠٥ ±٠,٣٨	cd ٣١,٤٤ ±٠,٤٦	a ٧١,٦٢ ±٢,٤٠
	Chickpea	F١١	cde ٢٤,٨٥ ±٢,٩٨	abc ٢,٨١ ±٠,٣٥	bc ١٣,٠٦ ±٠,٧٢	c ٢,١٤ ±٠,١٦	c ٥١,٤٣ ±٠,٨٤	d ٢٣,١٩ ±٠,٦٧	a ٢,٤٢ ±٠,٠٨	ab ٢,١١ ±٠,١١	f ١٦,١٦ ±٠,٥٤	g ١٤,٤٧ ±٠,٣١	g ١٩,٤٧ ±٠,٧٧	b ٦٤,٩٦ ±٠,٤٦
	Soybean	F١٢	def ٢٤,٤٧ ±٢,٨٤	a ٣,٤٥ ±٠,٤٣	d ١٠,٩٧ ±٠,١٩	ab ٢,٨٤ ±٠,٢١	d ٤٥,٤٤ ±٠,٦٤	ab ٢٦,٤٩ ±٠,٥٠	a ٢,٠٩ ±٠,٢٤	d ١,٦٩ ±٠,٠٣	cde ١٧,٤٣ ±٠,٠٢	fg ١٤,٥٣ ±٠,٣٩	efg ٢٢,٢٢ ±٢,٢٢	b ٦٣,٩٨ ±٠,٩٨
LSD (P<٠,٠٥)			٤,٤٢	٠,٩٨	١,٣٤	٠,٤٧	٤,٠١	١,٥٠	١,٠٦	٠,٢٢	٢,٠٢	٠,٩٣	١١,٣٨	٣,٦٧

Means with the same latter in the same column are not significant different (*P*>٠,٠٥).

Table ٥. Total viable, coliform group, *E. coli* and moulds and yeasts counts of different fresh and fried prepared vegetarian formulas.

Vegetable kind	Protein source	Formula No.	Total viable count		Coliform group		*E. coli*		Moulds and Yeasts	
			Fresh	Fried	Fresh	Fried	Fresh	Fried	Fresh	Fried
Cauliflower	Faba bean	F١	٧,٩٥x١٠^{٤}	٣,٩٥x١٠^{٦}	٦,٤٠x١٠^{٦}	–	١,١٥x١٠^{٦}	–	١,٨٠x١٠^{٢}	–
	Chickpea	F٢	٥,٠٠x١٠^{٤}	٦,٦٠x١٠^{٦}	٧,٨٠x١٠^{٦}	–	٢,٤٨x١٠^{٦}	–	٢,٧٥x١٠^{٢}	–
	Soybean	F٣	١,٩٣x١٠^{٤}	٣,٥٥x١٠^{٦}	٦,٦٥x١٠^{٦}	–	٣,٦٥x١٠^{٦}	–	٣,٥٠x١٠^{٢}	–
Green Pea	Faba bean	F٤	١,٠٧x١٠^{٥}	٨,٩٠x١٠^{٢}	١,٢٢x١٠^{٣}	–	١,٠٩x١٠^{٢}	–	٣,٧٥x١٠^{٢}	–
	Chickpea	F٥	٢,٦٥x١٠^{٤}	٧,٨٥x١٠^{٦}	١,٠٥x١٠^{٦}	–	٨,٧٥x١٠^{٢}	–	٤,١٠x١٠^{٢}	–
	Soybean	F٦	٤,٩٥x١٠^{٤}	٣,٣٥x١٠^{٢}	٦,١٥x١٠^{٢}	–	٣,٨٠x١٠^{٢}	–	١,٨٠x١٠^{٢}	–
Green Bean	Faba bean	F٧	٣,٦٥x١٠^{٤}	٧,٠٠x١٠^{٦}	٩,٩٠x١٠^{٦}	–	٧,٧٠x١٠^{٦}	–	١,٨٥x١٠^{٢}	–
	Chickpea	F٨	٥,٧٥x١٠^{٤}	٤,٣٥x١٠^{٦}	٨,٩٥x١٠^{٦}	–	٥,٢٥x١٠^{٦}	–	٢,٥٥x١٠^{٢}	–
	Soybean	F٩	١,٤٠x١٠^{٤}	٣,٧٥x١٠^{٢}	٣,٢٥x١٠^{٢}	–	٩,١٥x١٠^{٢}	–	١,٦٠x١٠^{٢}	–
Green Squash	Faba bean	F١٠	١,٠٦x١٠^{٥}	٩,٣٥x١٠^{٢}	٨,٩٥x١٠^{٦}	–	٤,٨٠x١٠^{٢}	-	٢,٠٠x١٠^{٢}	–
	Chickpea	F١١	٤,٢٥x١٠^{٤}	٥,٣٥x١٠^{٦}	١,٢٥x١٠^{٦}	–	٥,٤٠x١٠^{٦}	-	١,٩٠x١٠^{٢}	–
	Soybean	F١٢	١,٨٩x١٠^{٤}	٣,١٥x١٠^{٦}	٧,٣٠x١٠^{٦}	–	٨,٧٠x١٠^{٦}	-	٣,١٠x١٠^{٢}	–

– Not detected meaning.

Table ٦. Sensory evaluation of different fried prepared vegetarian formulas.

Vegetable kind	Protein source	Formula No.	Appearance	Taste	Odor	Texture	Juiciness	Overall acceptability (%)
Cauliflower	Faba bean	F١	٦,٢٣^{ab} ±٠,١٠	٥,٢٨^{cd} ±٠,١٤	٥,٥٣^{ab} ±٠,٠٩	٥,٢٠^{bc} ±٠,١٣	٥,٣٥^{abc} ±٠,١٤	٧٨,٧٩^{bc} ±١,١٠
	Chickpea	F٢	٦,٥٣^{a} ±٠,٠٨	٥,٧٨^{a} ±٠,١٣	٥,٦٨^{a} ±٠,١٢	٥,٧٠^{a} ±٠,١٠	٥,٦٥^{a} ±٠,١١	٨٣,٧٩^{a} ±٠,٧٧
	Soybean	F٣	٥,٨٠^{cd} ±٠,١٠	٥,٠٨^{def} ±٠,١٤	٥,١٥^{cd} ±٠,١٤	٥,١٣^{bc} ±٠,١٦	٥,٢٣^{bcd} ±٠,١٤	٧٥,٣٦^{d} ±١,٢٥
Green Pea	Faba bean	F٤	٥,٥٥^{ef} ±٠,١٢d	٥,٥٠^{abc} ±٠,١١	٥,٢٠^{bc} ±٠,٠٩	٥,٢٠^{bc} ±٠,١٢	٤,٨٣^{d} ±٠,١٢	٧٥,٠٧^{de} ±٠,٨١
	Chickpea	F٥	٥,٨٥^{cd} ±٠,١٠	٥,٦٣^{abc} ±٠,١٠	٥,٤٠^{a} ±٠,١٢	٥,٦٣^{a} ±٠,١١	٥,٤٠^{abc} ±٠,١٢	٧٩,٧١^{b} ±٠,٩٨
	Soybean	F٦	٥,٣٨^{efg} ±٠,١٠	٤,٧٥^{f} ±٠,١٥	٥,٠٨^{cde} ±٠,١٣	٥,١٥^{bc} ±٠,١٢	٤,٩٨^{cd} ±٠,١٤	٧٢,٣٦^{ef} ±١,١٣
Green Bean	Faba bean	F٧	٥,١٣^{g} ±٠,١٠	٥,١٠^{def} ±٠,١٥	٥,٠٠^{cde} ±٠,١٥	٥,٠٣^{bc} ±٠,١٣	٥,٠٣^{cd} ±٠,١٤	٧٢,٢١^{ef} ±١,٣٨
	Chickpea	F٨	٥,٣٠^{efg} ±٠,١٣	٥,٥٥^{abc} ±٠,١١	٥,٠٣^{cde} ±٠,١٤	٥,٣٥^{ab} ±٠,١٣	٥,٠٨^{b} ±٠,١٤	٧٥,١٤^{de} ±١,٣٨
	Soybean	F٩	٥.١٣^{g} ±٠,١١	٤,٧٥^{f} ±٠,١٥	٤,٨٠^{de} ±٠,١٣	٥,٠٨^{bc} ±٠,١٤	٤,٩٠^{d} ±٠,١٣	٧٠,٤٣^{f} ±١,٢٢
Green Squash	Faba bean	F١٠	٥,٥٨^{de} ±٠,١١	٥,٤٠^{bcd} ±٠,١٧	٥,٤٣^{a} ±٠,١٤	٥,٠٠^{bc} ±٠,١٥	٥,٢٠^{bcd} ±٠,١٥	٧٦,٠٠^{cd} ±١,٢٩
	Chickpea	F١١	٦,٠٠^{bc} ±٠,١٣	٥,٦٨^{ab} ±٠,١٠	٥,٥٠^{a} ±٠,١١	٥,٥٨^{a} ±٠,١٢	٥,٢٨^{ab} ±٠.١١	٨٠,٠٧^{b} ±٠,٩٣
	Soybean	F١٢	٥,٢٥^{fg} ±٠,١٢	٤,٨٥^{ef} ±٠,١٥	٤,٧٨^{e} ±٠,١٣	٤,٩٥^{c} ±٠,١٥	٥,١٥^{bcd} ±٠,١٥	٧١,٣٦^{f} ±١,٣٠
LSD (P<٠,٠٥)			٠,٣٠	٠,٣٧	٠,٣٥	٠,٣٦	٠,٣٧	٣,١٨

Means with the same latter in the same column are not significant different (*P*>٠,٠٥)