Effect of fortification the yellow lentils with some grains as an alternative to animal protein and its effect on the sensory properties and quality of the final product

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Abstract

Lentil is a plant food consumed in the world due to its high protein content, complex carbohydrates, dietary fiber, folic acid and bioactive phytochemicals such as flavonoids, total phenolics, and its functional and technological characteristics. Also, can used lentil as healthy diet and alternative meats for the vegetarian or consumers are minimizing or excluding meat. Therefore, this study was conducted to determine the effect of fortification the yellow lentil with some grains as an alternative to animal protein and its effect on the sensory properties and quality of the final product. The chemical composition determination included protein, dietary fiber, ash, vitamins, minerals and sensory evaluation. Four different formulations of kofta were prepared: 100% meat, 100% yellow lentil, 75% lentil with 25% bulgur and 75% lentil with 25% semolina. Samples were evaluated as acceptable by the panelists, but 25% bulgur had the highest acceptability compared to control samples. The results revealed a significant increase $p<0.05$ of proteins, fiber, and ash in lentils (25.2, 8.3, and 2.3), bulgur (10.02, 14.91,and 1.36) and semolina (14.56, 3.81,and 0.69), respectively. In addition, there is a significant variation in mineral and vitamin A content. The protein content in different formulations ranged between 25.75, 17.45, and 18.78 compared to the control kofta of 17.76.**Conclusion**: Lentil can fortify with some grains to improve human nutritional quality as an alternative meat and healthy status because of its low fat, high protein and fibre content. Also, lentils can be used as a substitute for beans in making falafel.

Key words

Lentils, grains, health benefits, meat alternatives.

Introduction

Because of the effect diet on overall health, there is increased interest in food and nutritional approaches that promote healthy lifestyles. So, with the development of technologies, sources and nutritional approaches can achieve a healthy lifestyle **(Eichelman *et al*., 2016).** New trends showed increasing use of pulses and low consumption of meat **(Hill, 2022)**, among new food sources pulses and grains are important sources of bioactive compounds **(Varzakas *et al*., 2016)**. In addition to rich foods in proteins of good nutritional quality, complex carbohydrates, high amounts of soluble dietary fibers, vitamins such as thiamin, folate and minerals such as iron, zinc, copper, manganese and phosphorus **(Margier *et al*., 2018; Joehnke *et al*., 2021)**, an example of a legume is Lentil, it is an important legume and a staple in Asian and African countries **(Joshi *et al*., 2017; Sidhu *et al*., 2022).** Lentil has gained increasing popularity among consumers in recent years, because they are opting for plant-based proteins. It is a source of minerals such as iron, zinc, potassium magnesium, selenium, folate, thiamine, niacin and vitamin B6 as well as macronutrients such as slow-digestible starch, protein and fiber **(Joehnke *et al*., 2021),** also it is rich in antioxidants, mostly associated with polyphenolic compounds, including flavonols, flavones, flavan-3-ols, proanthocyanidins, anthocyanidins, hydroxybenzoic, hydroxycinnamic acids, Isoflavones **(Ganesan and Xu, 2017).** Lentil contains 24.6% protein, 63.4% carbohydrates, 2.7% ash content, and 1.1% total fat, a high amount of dietary fiber, slowly digestible starch, potassium and low sodium. According to the health benefits of lentil, different studies have shown that the consumption of lentil has an effective effect in reducing various health problems for people with hypertension, cardiovascular diseases, diabetes mellitus, cancer

and reducing blood cholesterol levels due to its polyphenol composition, which has been shown to possess antioxidant, anti-inflammatory and nephroprotective effects **(Ganesan and Xu, 2017 ;Verni *et al*., 2020),** for instance, flavonoids in lentils control in blood glucose **(Zhang *et al*., 2015),** So lentils might be a functional dietary ingredient **(González-Sarrías *et al*.,2013)**. Also, the higher protein and lower carbohydrate content of lentils can help in developing new products. In addition, lentils have high dietary fiber, resistant starch and bioactive polyphenolic content **(Dhull *et al*., 2022).** Various studies have confirmed that lentil contains protein (15.9% to 31.4%), carbohydrates (43.4% to 74.9%), fat (0.3% to 3.5%), total fiber (5.1% to 26.6%), and ash (2.2–6.4%) **(Grusak, 2009)**. Bioactive compounds in lentil can act as antioxidants **(Ciudad-Mulero *et al*., 2020; De Pasquale *et al*., 2020; Dhull *et al*., 2020; Pasqualone *et al*., 2021; Xu *et al*., 2019).** Grains are a major source of the human diet, because of their bioactive components such as phytochemicals and dietary fiber **(Liu *et al*., 2020),** Among these grains is bulgur, which is a multipurpose food that can be used in salads, soups, baked goods, stuffing and meat substitutes in vegetarian recipes. It is utilized as a healthier **(Stone *et al*., 2020).** Burghul is rich macro- and micronutrient food product, such as vitamins such as vitamin B, especially B1, B2, B3, B5, and B6, minerals, protein, fibers, essential fatty acids and folate. It has high protein levels, calcium and iron **(Yousif et al., 2018)**. Bulgur is also a natural and functional food appropriate for vegetarian diets and, because of its folic acid content, is healthy food for pregnant mothers and babies **(Irvine *et al*., 2022)**. It is considered a healthy food due to its nutritional and medicinal properties, which include anti-carcinogenic, anti-microbial, anti-diabetic, and antioxidative properties. Burghul can be utilized for the production of value-

added economic food products **(Yilmaz and Koca, 2017; Shah *et al*., 2022)**. Bulgur is a healthy source of fiber in the diet **(Saka *et al*., 2020)**. Even after these procedures, the bulgur also has a higher proportion of dietary fiber approximately 18 g per 100 g **(Savas & Basman, 2016)**. According to (**Giambanelli *et al*, 2018; Tekin et al., 2021). I**t contains the highest antioxidant activity. According to **Kumar *et al*., (2013)** the antioxidant activity is mainly due to the phenolic compounds in the wheat grains such as flavonoids, it also provides many of the health benefits **(Yilmaz & Koca, 2017)**. Bulgur is included in many food applications; it is still a primary ingredient in Middle Eastern cuisine, India, and the Balkans. It is the key ingredient in tabbouleh (a bulgur salad with tomatoes, onions, and herbs) and kibbeh (ground meat patties with onions and spices) **(Al-Rousan *et al*., 2018).** Semolina is among the food cereals after rice, it has been used commercially and consumed as a food product in human diets. Semolina is the coarsely ground, purified middlings of the wheat kernel, it is characterized by its hardness, intense yellow color and nutty taste, it is a healthy food source for the human. Semolina is the principal material used in the manufacture of several food products, such as pasta, bulgur, couscous, mote, and unleavened bread, due to its sufficient amount of yellow pigment, protein content, and gluten characteristic **(Kabbaj *et al*. 2017; Pooja *et al*., 2022)**. It is a source of protein, complex carbohydrates, ash, and is rich in minerals such as iron, phosphorus and vitamins B (thiamine, niacin, and riboflavin) **(Giampiero *et al*., 2011)**. Semolina also has a high source of pro-vitamin A, antioxidants. Due to anthocyanin and its antioxidant properties, it is considered a healthy cereal and is recommended in the diet for those suffering from allergies, diabetes, and high blood cholesterol **(Pooja *et al*., 2022)**. The

slow rate of sugar digestion leads to a lowering of the glycemic index and the insulinemic response in humans **(Colasuonno et al. 2017; Colasuonno et al. 2019)**. Due to semolina is high digestibility, nutritional composition, and low cost, these properties make it suitable for human consumption due to its nutritional content; 12–16% protein content, 70% carbohydrate, 1.9% fat, 1.6% fiber, and 1.6% minerals **(Marcotuli *et al*. 2020)**. It contains high grain protein content together with yellow-colored carotenoid pigment **(Mazzeo *et al*. 2017).** Semolina also contains provitamin A, antioxidants, and low sodium content that are essential nutrients for the human diet. The goal of this research was to investigate the impact of fortifying yellow lentils with various grains as an alternative to animal protein on the sensory properties and overall quality of the final product.

Materials and methods

Materials

- Beefmeat, yellow lentil, bulgur, semolina, fresh onion, grice, and parsley were purchased from a local supermarket in Cairo, Egypt, to make kofta.

- Lentil, bulgur, and semolina were cleaned and sieved by hand to be free from sand, stones, and other foreign materials, and then they were soaked in boiling water for 30 minutes and ground using an electronic mill.

- Some vegetables, fresh onions, grice, parsley, and a little salt, were mixed well. The ingredients of the tested kofta formulation are listed in **Table 1**.

Preparation of kofta sample (kofta control, yellow lentil, bulgur, and semolina)

Technological methods

For the preparation of meat and lentil kofta, bulgur and semolina kofta. Four different formulations of kofta were prepared, consisting of 100% meat (control 1), 100% yellow lentil (control 2), 7 % yellow lentil added 25% bulgur and 75% yellow lentil added 25% semolina. The formulations were as described in **Table 1**. Add the lentils and some grains, 3% of fresh onions, 1% salt, 3% parsley and 1% spice mixture. Then kneaded until the dough was stored at refrigerated temperature (±4o C), they were formed and cooked in heavy oil for 5 minutes.

Table (1): Formulations of control kofta of meat (CM), control kofta of lentil (CL), lentil added bulgur (LB) and lentil added semolina (LS)

Ingredients (g)	Formulations of kofta amounts (%)			
	CM	CL	LB	LS
Meat	100	___	___	___
Lentil	___	100	75	75
Bulgur	___	___	25	___
Semolina	___	___	___	25
Salt	5	5	5	5
Onion	10	10	10	10
Grice	5	5	5	5
Parsley	10	10	10	10

* CM “Control meat “100% * CL “Control lentil “100%

*LB “75% lentil+25% bulgur” *LS “75% lentil + 25% semolina”

Preparation of volunteer people

Twenty males and females of different ages evaluated the produced kofta from lentils and some grains (bulgur and semolina) compared to the control samples.

Analytical method

Determination of Proximate Composition

Chemical analyses conducted on all samples consisted of the determination of protein, fat, dietary fiber and ash content. All analyses were performed following the official methods of analysis of the Association of Official Analytical Chemists **(AOAC, 2012).** The crude protein percentage was determined using the Kjeldahl method and the percentage nitrogen (%N) obtained was used to calculate the percentage crude protein using the relationship % crude Protein = % N X 6.25. The percentage of ash (%) was determined by incinerating the samples in a muffle furnace at 550°C for 4 hours. The ash was cooled in a desiccator and weighed. Carbohydrate content was calculated by difference. Digested carbohydrate was calculated by difference including fiber. Digested carbohydrate % = 100- (Moisture% +Protein% +Fat% +Fiber% +Ash %). The results were expressed as the average value.

Determination of Mineral Content

Mineral contents of lentils, bulgur and semolina were carried out according to the method **(Chapman, and Pratt, 1961).** All

minerals were determined by an atomic absorption spectrophotometer (Varian Spectra – AA 220).

Determination of Vitamins

The HPLC technique, as described by **Aslam *et al*. (2008)** was used for separation and quantification of folic acid, niacin, Pyridoxine, by a reversed-phase chromatographic method.

Sensory evaluation

Colour ,texture, ,taste, odour and overall acceptability of kofta were organoleptically evaluated using 20 trained panelists from Food Science and nutrition, home economic, Faculty of specific education, Fayoum University. They were asked to rate their acceptabilities of kofta samples according to nine point scale, ranging from the like extreme 9 to dislike extreme 1 point as described by **Meilgaard *et al* .(1999).**

Statistical analysis

The data were expressed as mean ± standard deviation. Statistical analysis system software using ANOVA was followed. The differences among means were determined for significance at $P<0.05$ using Duncan's multiple range test.

Results and Discussion

Macronutrients of raw lentil, bulgur, and semolina (per 100 g)

Macronutrient of raw lentil, bulgur and semolina are presented according to the data in **Table 2**, The higher component of semolina, bulgur and lentils is carbohydrate (74.96, 71.78 and 62.1) respectively, while the protein in lentil, bulgur and semolina was (25.2, 10.02 and 14.56) respectively. The fiber content was high in bulgur, lentil and semolina (14.91, 8.3 and 3.81) respectively. The lower component of lentils, bulgur and semolina was total lipid and ash. This result was in accordance to those obtained by **Moslem *et al*., (2016)** which reported that legumes such as mucuna bean, guillaume, bambara grand nut, jack bean and lentil contains a large amount of protein, carbohydrates, minerals such as iron, calcium, magnesium and potassium and vitamins, especially B group vitamins**. According to (Joshi *et al*., 2017; Dhull *et al*., 2022)** mentioned that lentils are a nutrient-rich legume, having high protein content, complex carbohydrates, dietary fiber , essential minerals, vitamins, and high energy value, , folic acid, so lentils are considered a healthy food nutritionally. Lentil also contains a number of bioactive phytochemicals, such as flavonoids, total phenolics, phytate, saponins, and tannins. Lentils can use as meat alternatives; consumers are minimizing or excluding meat consumption and opting for non-meat foods**.** According to **(Rathod and Annapure, 2016; Abd-El-Aziz *et al*.,**

2018 ;Ghazza, 2019) studied the chemical and nutritional assessment of bulgur grains, bulgur grains had 9.51 % of protein, 1.27% of ash and 1.21 of fibers and 82.79% of carbohydrates. **(Abd El Sattar and Mostafa, 2017)** evaluated different varieties of durum wheat physically, chemically and technologically as well as to investigate the possibility of using their semolina durum wheat varieties in preparing Pasta. Semolina of Bane Suif contain the highest content of crud protein which was 14.30% followed by Sohago which recorded 13.95%. Results of sensory evaluation indicated, overall acceptability scores of cooked Pasta made from semolina variety for all characteristics. Semolina durum wheat varieties contain crud fat from 0.49 to 0.82%, ash content from 1.41 to 1.65% and total carbohydrate from 83.26 to 84.96%, these results are in line with those **(Ficco *et al*., 2016 and Giannone *et al*., 2016).**

Table (2): Macronutrient of raw lentil, bulgur and semolina (per 100 g)

Nutrients/ g	Lentil	Bulgur	Semolina
Protein	25.2 ± 1.1^{ab}	10.02 ± 0.03^{cd}	14.56 ± 0.5^{ef}
Total lipid	2.01 ± 0.2^{cd}	1.92 ± 0.6^{ab}	1.69 ± 0.6^{ab}
Carbohydrates	62.1 ± 3^{ab}	71.78 ± 3.1^{cd}	74.96 ± 1.3^{cd}
Fiber	8.3 ± 0.1^{ab}	14.91 ± 1.5^{cd}	3.81 ± 0.8^{ef}
Ash	2.3 ± 2.1^{cd}	1.36 ± 0.11^{cd}	0.69 ± 0.03^{ab}

*On dry weight basis * Each mean value, within the same raw, followed by the same letter is not significant different at 0.05 level. * Each mean value is followed by ± standard deviation.

Minerals content of raw lentil, bulgur and semolina (per 100 g)

The results in **Table 3** indicate the mineral content of raw lentil, bulgur, and semolina. The high contents of potassium, phosphorus, magnesium, calcium, and iron in lentil, bulgur, and semolina were (670, 292, 58.78, 47.7 and 7.4), (408, 298.71, 161, 110 and 2.89) and (186.01, 135.87, 45.88, 17.13 and 1.21) respectively, but the lower components of lentil, bulgur, and semolina were sodium, zinc and copper. Legume seeds play an essential role in human diet and in various physiological and metabolic processes as they are exceptional sources of protein, minerals, vitamins, and bioactive compounds **(Magalhães *et al*.,2017).** Lentils are the most common legumes, which characterize different nutritional and chemical profiles **(Joshi *et al*., 2017),** it contains amounts of fibers and minerals including phytochemicals such as phenolic acids, flavanols, saponins and phytic acid as good antioxidant **(Durazzo *et al*., 2013),** so lentil consumption may be associated with health benefits such as a reduced risk of cardiovascular illness, cancer, diabetes, osteoporosis, hypertension, gastrointestinal disorders, adrenal ailments, and a reduction in low density lipoprotein (LDL) cholesterol **(Jacobs and Gallaher, 2004; Boye *et al*., 2010). (Bautista-Exposito *et al*., 2018; Zhang *et al*., 2018)** stated that Lentil rich in bioactive phytochemicals, as flavonoids, carotenoids, tocopherols, saponins, phytic acid, phytosterols and antioxidant activity**.** According to **(Abd-El-Aziz *et al*., 2018; Ghazza, 2019)** showed the minerals composition of burghul grains, the calcium content was high 1186.38 mg/kg followed by magnesium 752.45 mg/kg, folic acid content was high 14.38 mg/100gm. Using semolina in the manufacture of macaroni, Modern food science has revealed that pasta manufactured from semolina is rich in minerals such as iron, phosphorus, magnesium,

manganese, zinc, copper, molybdenum and selenium **(Dexter and Marchylo 2000; Cubadda *et al*., 2009; Cubadda *et al*., 2012).**

Table (3): Minerals content of raw lentil, bulgur and semolina (per 100 g)

Nutrients/ mg	Lentil	Bulgur	Semolina
Calcium	47.7 ± 1.2^{ab}	110 ± 0.01^{cd}	17.13 ± 0.01^{ef}
Phosphorus	292 ± 2.4^{ab}	298.71 ± 2.3^{ab}	135.87 ± 1.1^{cd}
Iron	7.4 ± 0.4^{ab}	2.89 ± 1.4^{cd}	1.21 ± 0.3^{cd}
Magnesium	58.78 ± 1.0^{ab}	161 ± 3.21^{cd}	45.88 ± 0.7^{ef}
Potassium	670 ± 2^{ab}	408 ± 2.22^{ab}	186.01 ± 0.04^{ef}
Sodium	6.93 ± 0.1^{ab}	16.48 ± 1.5^{cd}	0.98 ± 0.5^{ef}
Zinc	3.59 ± 0.3^{ab}	2.01 ± 0.04^{ab}	1.13 ± 0.03^{cd}
Copper	1.29 ± 0.2^{ab}	0.299 ± 0.1^{cd}	0.17 ± 0.02^{cd}

The data presented as mean ±SD. of three independent analyses.

Vitamins content of raw lentil, bulgur and semolina (per 100 g)

The data in **Table 4** showed vitamins content of raw lentil, bulgur and semolina. The results indicated that bulgur had high level of vitamin A (2198.87), Followed by lentils (68.54) and it nothing in semolina. Lentils are characterized by the high content in beta carotene (33.58). The high content of Niacin content was bulgur, followed by semolina and lentil (3.47, 3.25 and 1.47). These results are line in **Kaale *et al*., (2022)** mentioned that lentils are a nutrient food legume having high content, essential minerals, vitamins, high energy value, folic acid, so lentils are considered a healthy food nutritionally. Lentils also contain a number of bioactive phytochemicals such as flavonoids, total phenolics, phytate, saponins, and tannins. According to **(Abd El-Aziz *et al*., 2018; Ghazza, 2019)** stated the content of Niacin in burghul

grains was (7.40 mg/100gm). Semolina is containing essential vitamins B such as Thiamine, Niacin and Riboflavin **(Cubadda *et al*., 2009; Cubadda *et al*., 2012).**

Table (4): Vitamins content of raw lentil, bulgur and semolina (per 100 g)

Nutrients	Lentils	Bulgur	Semolina
Vitamin C mg	1.65±0.2^{ab}	**0.0**	0.0
Vitamin A UI	68.54±0.01^{ab}	2198.87±2.6^{cd}	0.0
Beta carotene µg	33.58±3.12^{ab}	0.97±0.04^{cd}	**0.0**
Niacin mg	1.47±0.5^{ab}	3.47±0.11^{cd}	3.25±0.31^{cd}

The data presented as mean ±SD. of three independent analyses.

Proximate chemical composition of Kofta samples

Proximate chemical composition of kofta sample fortified with bulgur and semolina compared to control kofta sample of meat and lentil showed in **Table: 5.** Lentil kofta achieved the highest level of protein (25.75 g), followed lentil kofta fortified with semolina (18.78) and lentil kofta fortified with bulgur (17.45). Bulgur is a nutrient food product and rich in the content vitamins, minerals, protein, and fibers **(Yasir Abbas Shah *et al*., 2022).** Bulgur has higher protein levels, calcium, iron, vitamin B1, and Niacin than other cereals like bread and pasta **(Yousif *et al*., 2018).** Semolina is as a ready source and high level of protein and complex carbohydrates**, a**ccording to **Adyati *et al*., (2019). I**nvestigated the physicochemical properties of semolina-based pasta incorporated with chickpea flour and dried Moringa leaves,

in generally, the results revealed to increase the hardness, springiness, and chewiness index of the pasta and able to increase the functional benefit of the pasta produced, the chemical composition of pasta achieved significantly higher ($p<0.05$) moisture, fat, protein, ash, total dietary fiber, and calcium content than those of control pasta.

Table (5): Proximate chemical composition of kofta samples (100 g)

Samples / Nutrients (g)	CM	CL	LB	LS
Protein	17.76 ± 0.18^{ab}	25.75 ± 0.01^{cd}	17.45 ± 0.3^{ef}	18.78 ± 0.1^{ef}
Total lipid	6.86 ± 0.18^{ab}	1.056 ± 0.5^{cd}	2.12 ± 0.1^{cd}	1.78 ± 0.03^{cd}
Carbohydrates	0.01 ± 0.02^{cd}	59.1 ± 0.8^{ef}	71.32 ± 0.15^{ab}	69.41 ± 0.2^{ab}
Fiber	0.00	28.61 ± 0.7^{cd}	4.38 ± 0.2^{ab}	3.29 ± 0.03^{ab}
Ash	3.96 ± 1.3^{cd}	1.58 ± 0.2^{ef}	0.69 ± 0.02^{ab}	0.48 ± 0.01^{ab}

* Data expressed as means ±standards deviation (n=3). Values in the same line with different letters are significantly different at $p<0.005$ using the LSD test.
*Carbohydrate was calculated by differences.

Sensory evaluation of kofta manufactured from lentil and some grains

The data in **Table 6** showed that all kofta products were acceptable by the panelists, but kofta (80% lentils and 20% bulgur) had the highest acceptability, but kofta of yellow lentil with semolina achieved a lower sensory evaluation. Kofta product containing 20% bulgur had significantly ($P<0.05$) the highest scores given by panalists for colour, taste, texture, odour and overall acceptability comparing with the other control samples.

According to **(Karin *et al*., 2020)** Mentioned that legumes are a good source of protein and fibre and compared the nutritional, functional and sensory properties of red lentils and black beans. Sensory evaluation classed the product made of germinated red lentils was the best. **(Abd-El-Aziz *et al*., 2018)** pointed to the replacing soybean concentrate with bulgur flour were acceptable. The results of sensory evaluation agreed with **(Al Shehry, 2015)** which estimated of semolina by wheat germ flour. The sensory evaluation of the tested products showed that most of the studied attributes were more preferable in case of the 10% whole wheat germ than all the other tested busbousa formulas.

Table (6): Sensory evaluation of kofta manufactured from lentil and some grains

Samples / Sensory evaluation	CM	CL	LB	LS
Colour	9.97 ± 0.01^{cd}	9.3 ± 0.5^{ab}	9.4 ± 0.1^{ab}	8.9 ± 0.3^{ab}
Taste	9.98 ± 0.2^{cd}	9.4 ± 0.2^{ab}	9.6 ± 0.03^{ab}	8.7 ± 0.1^{ef}
Texture	9.7 ± 0.12^{ab}	8.9 ± 0.6^{cd}	8.6 ± 0.11^{cd}	8.4 ± 0.14^{cd}
Odour	9.96 ± 0.3^{ab}	9.9 ± 0.1^{ab}	9.93 ± 0.12^{ab}	9.7 ± 0.2^{ab}
overall acceptability	9.9 ± 0.1^{cd}	9.8 ± 0.01^{cd}	9.96 ± 0.51^{ab}	9.5 ± 0.11^{ab}
Mean	9.762	9.46	9.498	9.04

*Values are expressed as mean ±SD * Significant at p≤0.05 using one way ANOVA test. *
LSD: Least significant difference.

Conclusion

Lentils are an essential part of diets in many countries due to their high protein, carbohydrates, dietary fiber, minerals content and a

variety of health promoting bioactive compounds. Lentils can be used in traditional cuisines and food product development, including plant-based alternatives to meat proteins. Bulgur is a plant-based food rich in beneficial nutrients, including dietary fiber, vitamins and minerals such as calcium, magnesium and iron. It is also high in protein, low in fat, high amount of leucine, valine, folic acid and niacin. Combination of burghul with other sources of protein would compensate the deficiency of certain amino acids such as lysine, and therefore it contributes to the improvement of the health state of the population. Bulgur can be utilized in the development of functional foods due to its stability and significant nutritional. Semolina is the type of wheat that it use commercially and consumed as a food product in human diets. It is used in various making several food products such as macaroni, pasta, spaghetti and couscous, due to the yellow pigment, protein content, and its gluten characteristic, semolina also has a high source of pro-vitamin A, antioxidants, carbohydrates, and non-starch polysaccharides. Due to anthocyanin and its antioxidant properties, it is recommended in the diet for those suffering from allergies, diabetes, and high blood cholesterol. So it can be used in fortification of some foods to benefit of its nutrients. The research also proposes that lentils can be used as a substitute for beans in making falafel due to their high protein content.

Samples of kofta

Meat kofta "control"


Lentil Kofta "control"


Bulgur Kofta


Semolina Kofta


Lentil flafel




الملخص العربي

تأثير تدعيم العدس الأصفر ببعض الحبوب كبديل للبروتين الحيواني و أثره علي الخواص الحسية و جودة المنتج النهائى

Effect of fortification the yellow lentils with some grains as an alternative to animal protein and its effect on the sensory properties and quality of the final product

الملخص العربي

يعد العدس غذاء نباتي يستهلك في العالم، و ذلك بسبب محتواه المرتفع من البروتين، الكربوهيدرات المعقدة، الألياف الغذائية، حمض الفوليك والمواد الكيميائية النباتية النشطة بيولوجيًا مثل الفلافونويد والفينولات الكلية، كما يتميز بخصائصه الوظيفية والتكنولوجية. يمكن استخدام العدس كغذاء صحي وبديل للحوم للأشخاص النباتيين أو المستهلكين الذين يرغبون بتناول كمات قليلة من اللحوم أو يستبعدونها. لذلك أجريت هذه الدراسة لتحديد تأثير تدعيم العدس الأصفر ببعض الحبوب كبديل للبروتين الحيواني وتأثيره على الخصائص الحسية وجودة المنتج النهائي. تضمنت الدراسة تحليل التركيب الكيميائي: البروتين، الألياف الغذائية، الرماد، الفيتامينات والمعادن، كذلك إجراء التقييم الحسي للمنتجات المصنعة من العدس. تم تحضير أربع تركيبات مختلفة من الكفتة: 100٪ لحم، 100٪ عدس أصفر، 75٪ عدس مع 25٪ برغل و 75٪ عدس مع 25٪ سميد، حيث تم تقييم العينات على أنها مقبولة من قبل اللجنة، ولكن عينة كفتة العدس المدعمة بنسبة 25٪ برغل كان له أعلى قبول مقارنة بالعينات الضابطة. وأظهرت نتائج التركيب الكيميائي للعدس زيادة معنوية ($p<0.05$) في البروتينات، الألياف والرماد (25.2، 8.3، و2.3)، والبرغل (10.02، 14.91، و1.36)، والسميد (14.56، 3.81، و0.69)، على التوالي. بالإضافة إلى ذلك، هناك تباين كبير في محتوى المعادن وفيتامين أ. تراوح محتوى البروتين في التركيبات المختلفة بين (25.75، 17.45، و18.78) مقارنة بالكفتة الضابطة البالغة (17.76). **الخلاصة:** يمكن تدعيم العدس بالبرغل أو السميد لتحسين الجودة الغذائية للإنسان كبديل للحوم والحالة الصحية بسبب انخفاض محتواه من الدهون وارتفاع محتواه في البروتين والألياف. يقترح البحث أنه يمكن استخدام العدس كبديل للفول في صنع الفلافل.

الكلمات المفتاحية: عدس، حبوب، الفوائد الصحية، بدائل اللحوم.

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