

Evaluation of certain Egyptian Al-Dokka mixes in some Egyptian governorates

Abstract

Al-dokka is a distinctive Egyptian meal commonly eaten with bread and olive oil. Its ingredients vary depending on the region or the family/vendor making it. Despite its low cost and long shelf life, it is at risk of extinction due to the trend towards fast and easy-to-prepare foods despite their low nutritional and health value. The study aims to evaluate the nutritional and health benefits of Egyptian al-dokka mixtures, produced in various Egyptian governorates, to revive the use of these ancient popular foods. The study collected al-dokka samples from 10 Egyptian governorates for sensory evaluation and analysis. The components included sesame, peanuts, chickpeas, pumpkin seeds, zucchini seeds, apricot kernels, date pits, coriander, cumin, and salt in different proportions according to each governorate. The results of the study indicate that the Egyptian al-dokka, an ancient popular dish, has a high nutritional value. A snack consisting of 100 grams of al-dokka with a loaf of baladi bread (black bread) and 20 grams of olive oil provides about one-third of the protein needs of an adult person weighing 70 kg, in addition to 72.2% of the fat needs. It also covers 17% to 20% of the carbohydrate needs, and provides about 34.6% and 44.1% of the total daily calories for adult men and women, respectively. Assiut and Sohag samples exhibited the highest phenol content and antioxidant activity, attributed to their high content of cumin and coriander. The Gharbia sample also, exhibited high antioxidant activity due to its high pumpkin seed content. The samples showed varying levels of saturated fatty acids (SFAs) and total unsaturated fatty acids (TUFAs), with SFAs ranging from 13.26% to 17.96% and TUFAs from 82.04% to 85.44%. High proportions of apricot kernels, date seeds, coriander, and cumin in Qena, Siwi, Assiut, and Sohag samples negatively impacted sensory characteristics and overall acceptance. Date seeds fibers increased mouth roughness, while high amounts of cumin and coriander reduced sensory measures. Apricot kernels cause lumps in the texture and are not recommended for consumption due to toxic substances like cyanogenic glycoside (amygdalin), which become more decomposes by kernels ground and releases cyanide. The mixtures from Alexandria, Sharkia, Ismailia, Port Said, Gharbia, and Cairo are recommended due to their health, nutritional benefits, and sensory properties.

1. Introduction

Al-dokka, also known as duqqa or dukkah or dukka, is a flavorful spice blend originating from Egypt. It consists of a mix of salt, black pepper, ground cumin, sesame, and coriander. In Egypt, it is commonly eaten with bread and olive oil. Despite its Egyptian roots, it has gained widespread popularity in various other countries (Mohamed and Abdel Salam, 2021). Egyptian al-dokka is a mix of dried and ground coriander, cumin, caraway, salt, pepper, roasted sesame, and ground peanuts (Green, 2015). Al-dokka is a distinctive Egyptian meal made of roasted nuts and spices. It tastes great in salads or combined with mayonnaise for dipping. It can also be used as a flavorful coating for chicken before grilling or pan-frying. The word "dukkah" is derived from the Arabic word "daq," meaning grinding, as the mixture of spices and nuts is ground together after being roasted (Davidson, 1999; Aggarwal and Bains, 2023). According to Demirçivi and Altaş (2016), al-dokka is a mixture of sesame seeds, cumin seeds, roasted hazelnuts or chickpeas, coriander, sea salt, and black peppercorns. Al-dokka is commonly used as a spice in the Middle East and is often served at the table as a condiment to be sprinkled over meals. In Turkey and Iran, it is used like salt and pepper and is frequently placed on tables in bowls or shakers, especially at kebab restaurants. In the West, it is used as a spice for grilled meats and is added to onions and salt to enhance the flavor of meat dishes, curries, seafood, vegetables, rice, salads, stews, and sauces. It is also used as a seasoning for grilled and fried meats in various Arab countries, particularly in the eastern Mediterranean. It is mixed with olive oil in Egypt and served as a bread dip (Katzer, 1998b). Al-dokka is a popular spice mixture in the Arab world, with its ingredients varying from country to country (Roden, 2008). The most well-known variations are Egyptian al-dokka and Palestinian al-dokka, especially in Gaza City. Al-dokka is known for its inexpensive ingredients and long shelf life, making it suitable for those with limited income, but many affluent individuals also enjoy it. The exact composition of the spice mixture may vary from one family or vendor to another, although there are common ingredients such as sesame, coriander, cumin, salt, and black pepper (Sortun, 2013). The mixture can be enhanced with additional ingredients such as marjoram, mint, thyme, and chickpeas, as suggested by Malouf and Malouf (2008). They also recommend using ginger, millet flour, and dried

cheese. In addition, modern variations may include pine nuts, pumpkin seeds, and sunflower seeds. Al-dokka is a significant part of Egyptian folklore cuisine, renowned for its high nutritional and health benefits. Sadly, this traditional dish is on the verge of disappearing due to the prevailing consumption patterns favoring fast-prepared and inexpensive options. This shift has led to the neglect of many old popular dishes celebrated for their nutritional and health value. In a study by **Mohamed and Abdel-Salam in 2021**, a modified al-dokka was developed by blending ground fermented wheat, sesame, coriander, cumin, chicory leaves, cinnamon, turmeric, and date seed powder. This al-dokka demonstrated hypoglycemic effects in diabetic rats and effectively lowered cholesterol, triglycerides, and LDL-Ch levels, while improving liver and kidney functions. Moreover, the diabetic rats that consumed the modified al-dokka showed higher insulin concentrations compared to the diabetic control rats. Furthermore, the formulated al-dokka was found to increase both serum and femur magnesium concentration. Hence, the formulated al-dokka could serve as a beneficial dietary supplement for managing diabetes. Insulin concentrations were observed to be higher in rats fed the formulated al-dokka, which may have contributed to reducing dyslipidemia and consequent cardiovascular problems. Sesamin in sesame seeds promotes cholesterol excretion into bile and regulates the activity of 3-hydroxy-3-methylglutaryl coenzyme A reductase, a critical enzyme in cholesterol production (**Liang et al., 2015**). Feeding on the formulated al-dokka reduced functional abnormalities caused by nephropathy, one of the most prevalent diabetic sequelae. This impact might be attributed to the hypolipidemic and antioxidant effects of phenolic compounds found in al-dokka components, notably sesame and coriander seeds and chicory leaves, as previously established (**Bopitiya et al., 2015; Yashin et al., 2017; Jancic et al., 2017; Mekky et al., 2019**). Sesame seeds also contributed to al-dokka's hypoglycemic impact since they include anti-diabetic lignans including sesamin (**Farbood et al., 2019**), phenolic compounds, and dietary fibers (**Ortega-Hernández et al., 2018**). Sesame oil had an anti-diabetic impact, reduced oxidative stress, and safely synergized with hypoglycemic medicines (**Gupta et al., 2017**).

Human nutrition is shifting towards plant-based products for their high nutritional value and affordability, aiming to combat the negative effects of low-nutritional fast foods (**Du et al., 2012; Muhamyankaka et al., 2013**). Al-dokka has a good amount of protein, fat, and carbs, as well as vitamins, dietary fiber, phenolic compounds, and flavonoids. It is an old popular cuisine that can help with a variety of nutritional issues because to its high protein and amino acid content (from sesame, peanuts, and chickpeas). Combining grains and legume proteins can create protein components that offer a balanced amino acid source, meeting physiological requirements and increasing protein nutritional value (**Henchion et al., 2017**). In addition to being high in fat, it is a low-cost alternative to red meat, reducing the negative impact of not eating meat and fat on the middle and lower classes owing to increasing food costs and population expansion. As protein consumption rises due to the health advantages and safety of animal proteins, there is a growing need for edible proteins derived from plants (**Du et al., 2012; Henchion et al., 2017**). Interest in these alternatives has lately developed due to a decrease in meat output due to agricultural land stability, high feed prices, and a severe irrigation water deficit. This is owing to an increase in issues caused by a growth in population and the number of refugees, as the number of refugees in Egypt has reached around 13 million people, as well as crises caused by supply shortages caused by continuous global wars with currency liquidity crises. To effectively utilize resources, it is important to offer a diverse range of food options that can meet the nutritional needs of consumers, especially those in the middle and lower socioeconomic classes, using easily accessible raw materials. The study aimed to assess the nutritional value of Egyptian al-Dokka mixes made with different combinations from various regions, aiming to revitalize traditional foods. These mixes, whether consumed alone or in combination with other foods, may address the deficiencies in macro- and micronutrients in the diet.

2. Materials and Methods

2.1. Materials

The raw materials used in the manufacture of al-Dokka include sesame (*Sesamum indicum*), chickpea (*Cicer arietinum* L.), peanut (*Arachis hypogaea* L.), pumpkin seed (*Cucurbita maxima* L.), apricot kernel (*Prunus armeniaca* L.), zucchini seed (*Cucurbita pepo*), coriander (*Coriandrum sativum*), cumin (*Cuminum cyminum*), date palm seed (*Phoenix dactylifera*), and table salt.

2.2. Chemicals and reagents

Every reagent used was analytical grade.

2.3. Methods

2.3.1. Collection of al Dokka samples

Samples were collected from different governorates within the Arab Republic of Egypt. The samples included components such as sesame, peanuts, chickpeas, pumpkin seeds, zucchini seeds, apricot kernels, date pits, coriander, cumin, and salt. These samples were collected from 10 different governorates, namely Cairo, Ismailia, Sharkia, Qena, Gharbia, Siwa, Alexandria, Port Said, Assiut, and Sohag. The composition of the sample components was confirmed by collecting multiple samples from each governorate, including samples from residents and restaurants. The samples were stored in tightly sealed glass containers and transferred to the laboratory for analysis and sensory evaluation. **Table 1** displays the approximate composition of the components used in the collected al-dokka from different governorates

Table 1 Presents the proximate composition of various components used in the production of Al-Dokka sourced from different governorates.

Ingredients	Sesame seeds	Peanut	Chickpea	Apricot kernels	Pumpkin seeds	Date seed	Zucchini seeds	coriander	cumin	salt
Governorate										
Cairo	1.0	1.0								*
Ismailia	1.0	1.0	1							*
Sharkia	2.0	1.0	1							*
Qena	4.5	2.5	2.5	1				*	*	*
Gharbia	4.5	2.5	2.5		1					*
Siwi	4.5	2.5	2.5			1		*	*	*
Alexandria	2.0	1.0					2			*
Port Said	2.0	1.0								*
Assiut	2.0	1.0						1	1	*
Sohag	2.0			1				1	1	*

*A simple sprinkle to adjust the taste.

2.3.2. Preparation of al Dokka

Except for the fine salt, all of the components (sesame, peanuts, chickpeas, apricot kernels, date pits, coriander, cumin, pumpkin seeds, and zucchini seeds) are roasted, and the last two are peeled. Each ingredient is then ground separately until smooth, and the components are combined in the proportions specified for each recipe.

2.3.3. Proximate analysis of al Dokka

The AOAC (2006) standard procedures were carried out in order to estimate the proximate composition. The moisture content was determined in an air dryer oven at 105°C for 3 hours, and the weight after constant drying was recorded. Ash content was determined by igniting the sample in a muffle furnace at 600°C until it was carbon-free. Crude fat was extracted using diethyl ether in a Soxhlet apparatus. Crude fiber was determined as residue after acid digestion followed by alkali digestion. The nitrogen content was determined using the Kjeldahl method and was used to calculate the protein content. Total carbohydrates were estimated using the following equation: Available carbohydrates = 100 – (moisture + protein + fat + fiber + ash).

2.3.4. Extraction of phenolic compounds

The samples' phenolic components were extracted in accordance with **Bhinder et al., (2019)**. Two extractions were performed using a methanol solution (80% v/v) as the solvent (mass volume ratio: 1:15). After the extracts were combined, filtered, and examined for phenolic acids and antioxidant activity.

2.3.5. Determination of total phenolic content

With minor modifications, the folin-Ciocalteu (FC) technique as described by **Saavedra et al. (2015)** was utilized to determine the total phenol concentration. After diluting the extract to 3.8 mL with 250 µL of FC reagent, the mixture was allowed to react for eight minutes. After adding 20% sodium carbonate (900 µL) and letting it stand in the dark for an hour, the absorbance at 750 nm was measured using a spectrophotometer. The gallic acid standard curve was created using the same parameters. Gallic acid (mg) was used to represent total phenols per gram of al-dokka (mg GAE/g).

2.3.6. Determination of flavonoid content

The flavonoid content was measured using an aluminum chloride assay based on the method outlined in Ref. (**Chen et al., 2020**) with some adjustments. A 0.5 cm³ sample extract was mixed with 2 cm³ of distilled water in a test tube. Then, 0.15 cm³ of 5% NaNO₂ was added, followed by 0.15 cm³ of 10% AlCl₃ after 5 minutes of incubation. After 1 minute, 1 cm³ of NaOH (1 M) was added. The volume was adjusted to 5 cm³ with distilled water, and after 10 minutes,

the absorbance of the solution was measured at 510 nm. The total flavonoid content of the samples was expressed as mg catechin equivalent per 100 g of the dry mass (mg CE/100 g). Catechin was used as a standard. All samples were analyzed in triplicate.

2.3.7. Determination of antioxidant activity

With certain adjustments, the DPPH technique (Lee et al., 2003) was used to measure the antioxidant activity. In order to make the stock reagent, 22 mg of DPPH were dissolved in 50 mL of methanol. To create the working solution, add 94 mL of methanol to 6 mL of stock solution. 0.1 ml of sample extract and 3.9 ml of DPPH solution were combined, vortexed for 30 seconds, allowed to react for 30 minutes, and then the mixture was absorbed at 515 nm. The DPPH solution without any additional extract was the control. % Scavenging activity was calculated as follows= $[(A_{\text{control}} - A_{\text{sample}})/A_{\text{control}}] \times 100$

where A is the absorbance at 515 nm.

2.3.8. Fatty Acids Composition

Preparation of fatty acids methyl esters

Fatty acid methyl esters (FAMES) are formed from total lipid by employing the fast technique described in ISO 12966-2 (2017). FAMES were produced by trans-esterification using methanolic potassium hydroxide (MPH) as an intermediary step prior to saponification. Exactly 0.1 g oil was put in a 5-ml screw-top test tube, and 2 ml of isooctane has been added before shaking the tube. MPH solution (0.1 ml, 2 N) was placed on a cap with a PTFE joint, tightened, and forcefully shaken for 30 seconds. The tube was permitted to stratify till the top solution became clear, after which the methyl ester-containing upper layer was decanted.

Gas Liquid Chromatographic (GLC) of Methyl Esters of Fatty Acids

FAMES were injected on HP 6890 series GC equipped with a DB-23 column (60m x 0.32mm x 25 µm). Carrier gas is N₂, using a flow rate of 1.5 ml/min and a splitting ratio (1:50). The injector set at 250°C, whereas the Flame Ionization Detector (FID) set at 280°C. The temperature was set as following.: 150°C to 210°C at 5°C/min, then stay at 210°C for 25 minutes. Peaks have been identified via comparing the retention periods of standard methyl esters.

2.3.9. Determination of Vitamin E, D and K by HPLC

A 10 g sample was combined with 0.5 g ascorbic acid, 40 ml methyl alcohol, and 10 ml of 1:1 potassium hydroxide in water and heated at reflux with stirring for 30 minutes. After cooling in an ice bath, the blend was quantitatively transferred into a separation funnel having 50 ml water, 10 ml methyl alcohol, and 50 ml hexane including 1.5 mg/100 ml butylated hydroxytoluene (BHT). The separated funnel was violently shaken for two minutes, allowing the phases to separate. The aqueous phase is eliminated and extracted two times with 20 mL of hexane involving 1.5 mg/100 mL BHT.

The analysis has been carried out using a HPLC system (Agilent Technologies, Germany) 1200 series including a variable wavelength detector (295 nm for V.E, 266 nm for V.D, and 280 nm for V.K) and a waters series 2695 quaternary solvent delivery system with a cooled autosampler at 4°C and a heated column compartment at 30°C. The compounds were separated using a 10 µm Bondclone 3.9 x 300 mm C18 column (phenomenex, Sydney, Australia) with a C18 guard column. The mobile phase was composed of water and methanol (5:95), with a flow rate of 1 ml/min.

Plozza et al. (2012).

2.3.10. Statistical analysis

The software package SPSS (copy 17, SPSS Inc., Chicago, USA) has been utilized to compare treatment means at a significance level of $p < 0.05$.

3. Results and Discussions

Table 2 shows the approximate composition of several AI-Dokka samples collected from various governorates.

Ingredients	Moisture%	Protein%	Fat%	Ash%	Crude Fiber%	Carbohydrates%	K. Calories/100 g
Governorate							
Cairo	4.1 ^f	23.6 ^b	52.9 ^a	3.6 ^d	7.7 ^d	7.8 ^h	602.1 ^a
Ismailia	5.4 ^{cd}	24.7 ^a	36.0 ^e	3.4 ^e	8.3 ^e	22.1 ^c	511.2 ^f
Sharkia	5.5 ^c	23.0 ^f	40.5 ^c	3.8 ^c	7.7 ^d	19.5 ^d	534.1 ^c
Qena	5.5 ^c	23.5 ^b	41.4 ^b	3.6 ^d	7.3 ^e	18.7 ^e	541.5 ^b
Gharbia	5.5 ^c	23.7 ^b	41.0 ^b	3.6 ^d	7.3 ^e	18.9 ^e	539.6 ^b

Siwi	5.5 ^c	21.9 ^e	37.5 ^d	3.6 ^d	8.5 ^c	23.0 ^b	517.3 ^e
Alexandria	6.4 ^a	21.7 ^c	36.2 ^e	4.3 ^a	7.0 ^f	24.5 ^a	510.2 ^f
Port Said	6.2 ^b	22.7 ^d	37.9 ^d	4.0 ^b	6.2 ^e	23.1 ^b	523.7 ^d
Assiut	5.1 ^c	21.9 ^c	40.9 ^b	4.0 ^b	11.5 ^a	16.7 ^e	522.1 ^d
Sohag	5.6 ^c	22.0 ^e	40.3 ^c	4.0 ^b	10.1 ^b	17.9 ^f	522.8 ^d

Table 2 shows the approximate composition of the al-dokka mixtures produced by different governorates in Egypt. As for protein, it is noted that the highest protein percentage was obtained from a sample taken from Ismailia Governorate (24.7%), which may be due to the composition of the sample, which consists of about two-thirds of the volume of peanuts and chickpeas, while sesame constitutes about one-third of the volume. It is known that peanuts contain a protein percentage of about 27.1%, chickpeas contain a protein percentage of about 24.7%, while sesame contains a protein percentage of about 20.14%, and similar results were confirmed by **Wada et al. 2021**. Here, the nutritional role of al-dokka appears, as a snack consisting of 100 grams of al-dokka with bread provides about 25 grams of protein, which is equivalent to one-third of the daily protein requirements for an adult weighing 70 kg (ideal weight). The snack also provides a high nutritional value for protein, as it consists of a mixture of essential amino acids that come from three different sources: sesame, peanuts, and chickpeas. It is also noted from the protein data that the difference between the highest protein percentage in a sample from Ismailia Governorate (24.7%) and the lowest protein percentage in a sample from Alexandria Governorate (21.7%) is 3%.

The Cairo Governorate's mixture of sesame and peanuts contains the highest fat percentage of 52.9%, compared to other governorate mixtures. This is likely due to the high fat content in both sesame and peanuts, reaching 52.8% and 53.2%, respectively. **Wada et al. (2021)** reported similar results on sesame and peanuts. It is also noted that increasing the percentage of chickpeas in the sample leads to a decrease in the percentage of fat in it. Despite high oil content in apricot kernel seeds, pumpkin seeds, and zucchini pulp seeds, their low addition percentage in mixtures prevented an increase in fat percentage, as seen in Qena, Gharbia, and Sohag governorates. Ismailia and Alexandria have seen the most significant reduction in fat percentage. Samples with apricot kernels were found to be more clumpy and had an undesirable taste compared to other samples. Apricot kernels may improve liver function and lipid peroxides in rats (**Abdel-Rahman, 2011**), but they contain amygdalin, a cyanogenic glycoside, which is not recommended for consumption due to potential health risks (**Holzbecher et al., 1984**). Amygdalin is broken down into hydrogen cyanide, glucose, and benzaldehyde by emulsin, a para-glucosidase found in apricot kernels. Consuming ground apricot kernels can release large amounts of cyanide, potentially leading to chronic poisoning in third world areas (**Suchard et al., 1989 and Jones, 1961**). Consumption of apricot seeds, fruits, bitter almonds, cassava, and bamboo shoots can lead to the production of cyanide, a potential chronic toxicity threat (**Montgomery, 1969 and Seigler, 1975**).

The samples showed a close proportion of ash content, ranging between 3.4% and 4.3%. Samples from Assiut and Sohag showed the highest crude fiber content at 11.5% and 10.1%, respectively, which not affecting mouthfeel or texture, while Siwa's 8.5% fiber content had clear roughness and effected on their quality. The mouth's taste and texture were unfavorable due to the fibers derived from date pits, which comprise 15% from date pits weight. Despite The fiber content in Siwa and Ismailia samples was equal, but The fiber in Ismailia sample did not affect the mouth's taste or texture, resulting in a highly desirable taste. The data indicates that the fiber percentage in the samples ranged from 6.2% to 11.5% of the sample composition.

As for carbohydrates, their content ranges between 7.8% and 24.5%. A 100g al-dokka snack with 80g local bread provides 17%-20% of daily carbohydrate needs, ranging from 400-500g per adult per day. Consuming a 100g snack (contains 45 fat) with 20g of olive oil provides 65g of fat, a daily intake from fat almost ranged between 50-100g for adults, with some organizations recommending a maximum of 90g. Thus, the body gets about two-thirds of its daily fat needs from this snack.

Considering the calories from this meal, where a loaf of black bread provides 80 grams containing 60 grams of carbohydrates, which gives 240 calories. The addition of 20 grams of olive oil provides 180 calories. The 100 grams of al-dokka contain an average of 550 calories, with a range of 517 to 602 calories. This meal gives 970 calories, which represents about a third of an average-effort adult man's need (2800-3000 calories) and almost half of an average-effort adult woman's need (2200 calories).

Commented [MF1]: Sources can be updated.

From this perspective, it becomes clear that Egyptian al-dokka, one of the ancient traditional dishes, has a great nutritional value. When we take into account the international health and nutritional guidelines that recommend including sesame, chickpeas and peanuts in the diet, as they are considered functional ingredients that enhance food, it becomes clear to us the importance of these traditional dishes from a nutritional and health perspective (although it is difficult to list their details in this limited context).

Table 3 shows the sensory attributes of various Al-Dokka from different governorates.

Ingredients	Color	Smell	Taste	Appearance	Texture	Mouth Feel	Overall acceptability
Governorate							
Cairo	7.8 ^c	8.0 ^d	7.8 ^c	8.3 ^d	7.8 ^d	7.0 ^g	7.8 ^d
Ismailia	9.0 ^c	9.5 ^a	9.8 ^b	9.8 ^b	9.0 ^b	9.0 ^c	9.3 ^b
Sharkia	9.3 ^b	9.5 ^a	9.8 ^b	9.8 ^b	9.0 ^b	9.3 ^b	9.4 ^b
Qena	6.8 ^f	8.3 ^c	7.8 ^c	7.8 ^c	6.8 ^f	7.5 ^f	7.5 ^e
Gharbia	7.8 ^c	8.5 ^b	8.5 ^c	8.3 ^d	7.0 ^e	8.0 ^c	8.0 ^d
Siwi	6.5 ^g	8.3 ^c	8.3 ^d	7.0 ^f	6.0 ^g	6.8 ^h	7.1 ^f
Alexandria	9.5 ^a	9.5 ^a	10.0 ^a	10.0 ^a	9.3 ^a	9.5 ^a	9.6 ^a
Port Said	8.5 ^d	8.5 ^b	8.5 ^c	9.0 ^c	8.5 ^c	8.8 ^d	8.6 ^c
Assiut	4.5 ⁱ	5.0 ^e	4.3 ^f	5.5 ^g	5.3 ^h	4.8 ⁱ	4.9 ^g
Sohag	4.8 ^h	4.3 ^f	3.3 ^g	5.3 ^h	4.5 ⁱ	3.8 ^k	4.3 ^h

Table 3 summarizes the sensory characteristics of Egyptian al-dokka prepared in different governorates. Chickpeas enhanced the color of the mixture, while high proportions of apricot kernels, date kernels, coriander, and cumin in Assiut and Sohagian al-dokka led to a deterioration in color. The addition of cumin and coriander in large proportions, as seen in Assiut and Sohagian al-dokka, made the smell unacceptable, whereas small quantities were used to control the taste. The addition of cumin and coriander in large amounts, as seen in Assiut and Sohagian al-dokka, intensified the taste, while apricot and date kernels also made it unpalatable. Adding cumin, coriander, apricot kernels, and date pits to the dish made its appearance, texture, and mouthfeel unacceptable, particularly regarding fibers (resulting from date pits) and clumps resulting from adding apricot kernels. The unacceptable smell and appearance when apricot kernels are added also affect the overall acceptance. Despite the great health benefits of cumin and coriander when added to the mixture, Assiut and Sohagian al-dokka recorded the lowest acceptance rate. So did Siwan al-dokka to which date seed were added. Alexandrian al-dokka and those imported from Sharkia and Ismailia recorded the highest acceptance rate (9.6, 9.4 and 9.3 respectively). Based on the sensory and nutritional evaluation, we recommend using the mixtures produced from the following governorates: Alexandria, Sharkia, Ismailia, Port Said, Gharbia and Cairo in terms of health and nutritional benefits and sensory characteristics.

Table 4 shows the antioxidant activity and total phenolics, flavonoids, vitamins D, E, and K content of Al-Dokka samples collected from several governorates.

Ingredients	DPPH	T- Phenols mg/100g	T Flavonoids mg/100g	VD µg/100g	VE mg/10g	VK µg/100g
Governorate						
Cairo	47.8 ^c	128.8 ^b	10.11 ^a	33.4 ^c	16.2 ^c	8.91 ^e
Ismailia	68.4 ^c	120.0 ^d	6.24 ^c	32.8 ^c	17.8 ^c	20.06 ^c
Sharkia	92.9 ^a	114.5 ^e	3.09 ⁱ	41.6 ^b	24.3 ^d	20.85 ^c
Qena	82.6 ^b	112.8 ^f	6.88 ^d	57.3 ^a	36.1 ^c	23.40 ^b
Gharbia	91.2 ^a	110.5 ^f	3.95 ^g	23.1 ^d	44.9 ^a	27.7 ^a
Siwi	56.3 ^d	118.4 ^d	3.32 ^h	24.0 ^d	40.1 ^b	25.34 ^b
Alexandria	26.4 ^g	119.3 ^d	6.33 ^c	38.4 ^b	41.0 ^b	17.87 ^d
Port Said	31.2 ^f	119.2 ^d	9.64 ^b	57.3 ^a	46.6 ^a	9.09 ^e
Assiut	94.9 ^a	124.5 ^c	4.95 ^f	11.9 ^e	22.2 ^d	18.36 ^d
Sohag	88.4 ^a	147.5 ^a	8.63 ^c	11.4 ^e	19.9 ^c	10.22 ^e

The data in **Table 4** show the antioxidant activity and content of total phenolics, flavonoids, vitamins D, E and K in the samples of al-dokka taken from different governorates. The samples from Assiut, Sharkia, Gharbia, and Sohag showed the highest antioxidant activity, ranging from 88.4% to 94.9%. In contrast, the samples from Alexandria and Port Said recorded the lowest antioxidant activity with values ranging from 26.4% to 31.2%.

The samples all share a common factor: sesame, which has antioxidant activity due to sesamin and sesaminol compounds, along with vitamin E (Hirata et al., 1996). Sesamin, a natural antibacterial, antiviral, and anti-inflammatory oil, protects the liver from oxidative damage, increases fat burning, and is used in treating chronic diseases like hepatitis, diabetes, and migraine (Penalvo et al., 2006 and Nahar and Rokonouzman, 2009). Roasted sesame oil, rich in antioxidants, resists rancidity and enhances fried product taste. Oral consumption may inhibit pro-inflammatory cytokine production, protecting against lead and lipopolysaccharide-induced liver injury (Hsu et al., 2007). Sesamol, a potent antioxidant, has potential therapeutic benefits by scavenging reactive oxygen species and increasing vitamin E recycling. Sesame flour is high in protein, methionine, and tryptophan. (Ide et al., 2003).

The Sohag sample had the highest phenolic content, followed by Cairo and Assiut samples, with each having varying levels of phenolics. The high phenol content in Assiut and Sohag samples is attributed to the increased proportion of cumin and coriander, resulting in increased antioxidant activity.

The Cairo sample had the highest total flavonoids content at 10.11 mg/100 g, followed by Port Said at 9.64 mg/100 g and Sohag at 8.63 mg/100 g. In contrast, the Sharkia sample recorded the lowest content of flavonoids at a rate of 3.09 mg/100 g.

Vitamin D content increased significantly in Qena and Port Said samples, followed by Sharkia and Alexandria samples with 41.6 and 38.4 µg/100 g, respectively. Assiut and Sohag samples had the lowest vitamin D content, with 11.9 and 11.04 µg/100 g, respectively.

As for vitamin E, the highest statistical content was recorded in the Port Said and Gharbia samples with a content of 46.6 and 44.9 mg/100 g, respectively, followed by the Alexandria and Siwa samples with a content of 41 and 401 mg/100 g, respectively, without statistical differences between them. In contrast, the samples with the lowest vitamin E content were those taken from Cairo, Ismailia and Sohag with a content of 16.2, 17.8 and 19.9 mg/100 g, respectively, without statistical differences between them.

As for vitamin K, the highest content was recorded in the Gharbia sample, which may be due to the high percentage of pumpkin seeds, followed by the Siwa sample, which contains dried date pits, and then the Qena sample, which contains apricot pits. In contrast, Cairo, Port Said and Sohag samples recorded the lowest vitamin K content statistically with contents of (8.91, 9.09 and 10.22 µg/100g).

Sesame is included in all prior formulations in substantial quantities and has a major influence on the level of antioxidants and vitamins, because it includes numerous useful components. (Mekky et al., 2019; Agidew et al., 2021; Sallam et al., 2021, Ma et al., 2022; Wei et al., 2022; Mostashari and Mousavi Khaneghah, 2024).

Table (5). Fatty acid composition (% oils of sample) extracted from different sample of Al-dokka

Fatty Acid	Governorate	Cairo	Ismailia	Sharkia	Qena	Gharbia	Siwi	Alexandria	Port Said	Assiut	Sohag
		Area %	Area%	Area%	Area %	Area%	Area %	Area%	Area%	Area %	Area %
Saturated Fatty Acids (SFA)											
Lauric acid C12:0							0.68			0.66	0.56
Myristic acid C14:0		0.04	0.07	0.04	0.05	0.16	0.39	0.03	0.06	0.12	0.11
Palmitic acid C16:0		9.66	9.70	9.48	9.03	10.17	9.77	9.58	10.48	9.28	7.74
Margaric acid C17:0		0.07	0.12	0.06	0.06	0.06	0.07	0.05	0.06	0.06	0.04
Stearic acid C18:0		4.19	4.24	4.94	4.63	5.40	4.76	6.03	6.43	4.56	4.28
Arachidic acid C20:0		1.02	0.90	0.88	0.77	0.69	0.77	0.62	0.59	0.93	0.44
Behenic acid C22:0		1.58	1.34	0.94	0.99	0.79	1.52	0.12	0.15	0.79	0.09
Total saturated fatty acid (TSFA)		16.56	16.38	16.35	15.53	17.26	17.96	16.44	17.77	16.40	13.26
Mono unsaturated Fatty Acids (MUFA)											
Palmitoleic acid C16:1		0.10	0.11	0.12	0.10	0.06	0.11	0.14	0.13	0.13	0.29
Hepatadecenoic acid C17:1		0.05	0.08	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.07
Oleic acid C18:1		44.04	42.65	42.50	37.25	37.11	41.90	40.38	41.24	46.66	52.22
Gadoleic acid C20:1		0.93	0.73	0.57	0.51	0.42	0.60	0.20	0.20	0.57	0.18
Total Mono unsaturated Fatty Acids (MUFA)		45.11	43.57	43.22	37.90	37.62	42.65	40.75	41.60	47.39	52.76
Poly unsaturated Fatty Acids (PUFA)											
Linoleic acid C18:2		38.03	39.42	40.05	36.76	44.81	39.03	41.48	40.27	35.96	32.44
Linolenic acid C18:3n3		0.30	0.63	0.38	9.72	0.32	0.36	0.44	0.36	0.26	0.24
Total Poly unsaturated Fatty Acids (TPUFA)		38.33	40.05	40.43	46.49	45.13	39.39	41.92	40.63	36.21	32.68
Total unsaturated Fatty Acids (TUFA)		83.44	83.62	83.65	84.38	82.74	82.04	82.67	82.23	83.60	85.44
Total Fatty Acids (TFA)		100	100	100	100	100	100	100	100	100	100

The data in Table (4) showed that palmitic acid was the main component of saturated fatty acids (SFAs) in the different samples, followed by stearic acid in terms of percentage. The sample taken from Siwi recorded the highest percentage of saturated fatty acids (17.96%) compared to the sample taken from Sohag, which recorded the lowest percentage of saturated fatty acids (13.26%). On the other hand, oleic acid was the most abundant component among monounsaturated fatty acids (MUFA). The sample taken from Sohag recorded the highest percentage of monounsaturated fatty acids (52.76%), while the sample taken from Gharbia recorded the lowest percentage (37.62%). The sample taken from Qena also recorded the highest percentage of polyunsaturated fatty acids (46.49%) compared

to the other samples, while the sample taken from Sohag recorded the lowest percentage (32.68%). The sample taken from Sohag recorded the highest percentage of total unsaturated fatty acids (TUFA), while the sample taken from Siwa recorded the lowest percentage (82.04%). It is noted that the content of total unsaturated fatty acids in all samples taken from different governorates ranged between 82.04% and 85.44%, and these high percentages reduce the risk of coronary heart disease in humans. These results are consistent with the recommendations of (Ma et al., 2022) regarding increasing the consumption of total unsaturated fatty acids and reducing saturated fats.

4. Conclusion

The ingredients of the al-dokka vary according to the region or the family/vendor who makes it. It is a popular food that is at risk of disappearing despite its high nutritional and health value. It contains many ingredients that many parties recommend using as functional materials in food fortification, such as sesame, peanuts, and chickpeas. The research aimed to assess the nutritional value of Egyptian al-dokka mixtures, highlighting popular foods with high nutritional value, especially in light of high prices and severe food shortages. Consuming a 100-gram serving along with a loaf of black bread and 20 grams of olive oil, it provides 34.6% and 44.1% of the total daily calorie needs for men and women, respectively as well as one-third of an adult's protein requirements, 72.2% of their fat requirements, and 17%-20% of their carbohydrate requirements. The results also showed an increase in the content of antioxidants, total phenolic compounds as well as total unsaturated fatty acids from 82.04% to 85.44% in the different samples with an increase in the nutritional value and sensory quality characteristics. However, high proportions of apricot kernels, date pits, coriander, and cumin in Qena, Siwi, Assiut, and Sohag recipes led to a deterioration in sensory characteristics. Based on the sensory and nutritional evaluation, we recommend using the mixtures produced from the following governorates: Alexandria, Sharkia, Ismailia, Port Said, Gharbia and Cairo, due to their health and nutritional benefits and sensory properties.

Commented [MF2]: Conclusions need to be more abbreviated.

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