J. Food and Dairy Sci., Mansoura Univ., Vol. 10 (7): 231- 236, 2019

Incorporation of Okra Seeds Powder to Employ in some Foodstuffs Based on its Physical, Chemical and Sensorial Evaluation

Abouel-Yazeed, A. M.
Food Science Dept., Fac. Agric. (Saba Basha), Alex. Univ. Alexandria, Egypt.

ABSTRACT

In the current paper, okra of Egyptian variety (*Abelmoschus esculentus* L.) seeds dry were used to assess physical characteristic, chemical analysis and applying of the seed for fortifying foods. Analysis including pH value, bulk density (g/ cm^3), crude protein (%), crude fiber (%), total phenolic (mg GAE/100g) and antioxidant activity (%)were 6.43, 0.56, 23.95, 24.81, 34.29, 50.43, respectively. Moreover, considerable mineral contents. Also, the great of essential amino acids (EAA) were leucine (6.71%) followed by lysine (5.22%). The most abundant fatty acid in oil is linoleic acid (38.35 %), followed by palmitic acid (28.98 %), oleic acid (24.38 %) as well as stearic acid (4.14 %).However, the crude oil showed low peroxide values in addition to free fatty acids being (1.41 $meqo_2$/Kg oil) and (1.13 as % oleic acid) indicating its high stability to deterioration. In addition, sensory evaluation presented can useful application it for the fortification of several foodstuffs based on its physical as well chemical analysis. Furthermore, the investigation was prepared to get a detailed line the various constituent of okra seeds that possibly will be beneficial for the interest of both industrial and nutritional.

Keywords: Seeds of okra, physical, chemical analysis, oil properties, protein, fortification and sensory evaluation.

INTRODUCTION

Okra vegetable (*Abelmoschus esculentus* L. Moench) is unique and generally of great benefitas well as used in medicine as diuretic agent contained various varieties of polysaccharides, fat substitute and as food desirable. Moreover, an economically main crop (Minh *et al.*, 2019 and Aleem *et al.*, 2019).

Okra seeds content of great quality from protein as mainly, essential amino acids (EAA). Therefore, it has the function a necessary part in the customer foodstuffs. It includes also, vitamins, minerals, phenolic compounds, antioxidant, carbohydrates, oil is to a valuable source of antioxidants and essential fatty acids. Moreover, Okra is considered as an important source of these compounds (Gbadegesin *et al.*, 2018 and Petropoulos *et al*., 2018).

Further, the difference in chemical analysis has been described among various okra species also, various growing state in addition to harvest stage (Gemede *et al.*, 2016).

Fortification of the food produce benefits necessary to reduce the symptoms of protein-energy malnutrition in children besides about adults.so, It is essential for the increasing applying of the seed for fortify foodstuffs (Gbadegesin *et al.*, 2018).

In the lately, the employment of food not just for feeding but as well for health. Now, food manufacture working on to increase the mixture of components for enhanced nutritional status to the evolution of healthy foods for healthy living. Snacks as biscuit are ready to eat and are mostly agreeable as a rest for a short time hunger or eat in the middle of meals (Akoja and Coker 2018).

In the current paper, dried seeds from okra as Egyptian type (*Alruwmiu*) were utilized to assess physical characteristic, chemical analysis and applying of the seed for fortifying foods. Furthermore, the investigation was prepared to get a detailed line the various constituent of okra seeds that possibly will be beneficial for the interest of both industrial and nutritional.

MATERIALS AND METHODS

Materials:-

Samples preparation of the okra seeds:-

The okra (*Abelmoschus esculentus* L.) of unique Egyptian variety (*Alruwmiu*) was obtained from a farm, Alexandria Governorate, Egypt (during summer, 2018). The foreign matters and infested seeds were removed manually. The fresh matured green okra pods were washed under running portable water to remove dirt. The seeds were manually removed from ripe fruit, dried in an electric oven at 40°C for 72hr, selected and milled in an electrical mill to obtain fine flour (Mujumdar, 1995 and Eze and Akubor ,2012).The milled material was sieved through an aluminum sieve (powder) then stored in glass containers at 4°C in the refrigerator until analysis.

Chemicals and reagents:

Solvents, chemicals, and reagents were obtained from El-Gomhouria Company, Alexandria, Egypt, and Sigma–Aldrich (Germany). All chemicals in addition to reagents used were of analytical grade.

Other ingredient:-

Wheat flour, chicken meat and other basic baking ingredients, sugar, powdered milk, eggs, baking powder, salt and others were procured from the local market in Alexandria,, Egypt.

Preparation of chicken nuggets:-

Preparation of chicken nuggets substituted with 2% and 4% of okra seed powder (flour). The chicken were stripped from the skin and bones then minced, through a 4 mm plate (National UK -G 20 NR, Japan). . Mixed the minced chicken meat formula (100% meat (M), 98% meat + 2% okra seed powder (M1), 96% meat + 4% okra seed powder (M2), flour, water and seasonings. After that samples coated with breading materials. Coated and breaded nuggets were cooled at freezer and then placed in aluminum foil and stored for approximately six hour. The samples were removed from the freezer then fried for 2-3 minutes, until the colour is light yellow in accordance with Sanchez- Alonso *et al.*, (2007) with slight modification.

Preparation of biscuits:-

Preparation of biscuits substituted wheat flour with 5, 10 and 15% of okra seed powder (flour).

Biscuits were prepared using the method as described by Chinma *et al.*, (2011). Mixed the formula (100% wheat flour (B) , 95% wheat flour + 5% okra seed powder (B1), 90% wheat flour + 10% okra seed powder (B2) and 85% wheat flour + 15% okra seed powder (B3)). Then added fat and sugar were mixed in a Kenwood mixer (HM 450) until the mixture was thinning. Eggs and milk were added while mixing continued. Baking powder, and salt were introduced into the mixture to form a dough. The cut mass was transferred to a greased baking tray. Baking

was carried out at 180°C for 15 min. Samples were removed from the oven, allowed to cool and packaged.

Analytical methods:-

Physical and physicochemical procedure

Physical and physicochemical procedure of okra seeds containing 100 seed mass, weight of seeds, seed dimensions (thickness length as well as width),bulk density and pH were determined using the method as described by (Calisir *et al.*, 2005and AOAC, 2010).

Chemical methods

Determination of proximate composition. The samples were analyzed for moisture, protein, fat, ash and fiber by the methods of (AOAC, 2010). Phenolic content as (mg GAE/100g) equivalent was assayed calorimetrically using the method as described by of Hagerman and Butler (1978). Antioxidant activity was measured by the N, N–dimethyl–P–phenylenediamine dihydrochloride (DMPD) as described by Fogliano *et al.*, (1999). Some minerals as (Ca, Fe, and Zn) were measured according to (AOAC, 2010) by Perkin Elmer Atomic Absorption Spector photometer (M- 2380).Moreover, K was measured by flame photometer (PE-England).

Determination of functional properties of powder samples as water absorption capacity and oil absorption capacity using the method described by AOAC (2010). Determination of chemical analysis of okra seed oil, A quantity of powder was subjected to extraction by chloroform: methanol (2:1v/v) as described by Folch *et al*., (1957)and using rotary evaporator at 40°C to remove the solvent as well as the oil stored in a sealed glass at -18°C up to analysis. Peroxide value (PV as meqo2/Kg oil), iodine value (IV) and Free fatty acids (as % oleic acid) were measured according to AOCS (1997).

Determination of amino acid profile:-

Amino acid content of leaves sample hydrolysates were prepared following by the method of (Spackman *et al.*, 1958) by using (SYKAM S 433 Amino Acid Analyzer).

Determination of Fatty acid profile:-

After total lipids were extracted with a mixture of chloroform, methanol (2:1, v/v) as outlined by the procedure of Folch. Fatty acid methyl esters of oil samples were prepared as described by Radwan (1978) in screw cap vial using 1% H2 SO4 in methanol under stream of nitrogen gas. The closed vials were heated in an oven at 90 °C for 90 min. Gas chromatographic (GC) investigation was carried out by ACME model 6100 GC (Young LTN Instrument Co., Korea), capillary column with a 0.25 – mm i.d. and 0.2 - µm film thickness (Supelco Bellefonte, PA), fitted with a split/splitless injector and FID detector. Standard fatty acid methyl esters were used for identification.

Sensory evaluation

Coded samples were subjected to sensory evaluation (IFT, 1981 and Adegunwa *et al.*, 2014). The parameters evaluated include colour, odour, texture, and overall acceptability by a panel of the judges from the Food Science Department,. The coded samples were served in a clean white plastic plate at room temperature. Sample presentation to the panelists was at random and one at a time. They were to evaluate the samples and check how much they liked or disliked each one and rate them as such using a 9-point hedonic scale system in which 9 represent like extremely and 1 represent dislike extremely.

Statistical analysis

All the analyses were carried out and expressed as mean and standard deviation (SD).

Data were statistically analyzed by analysis of variance (ANOVA) and significant differences were identified by Duncan's Multiple Range test (p= 0.05). (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Physical and chemical analysis of seed from okra

Physical characteristic of okra seed

Physical characteristic is essential in predicting the storage safety. (Acikgoz *et al*., 2016). The characteristic of seed from okra is displayed in Table (1), bulk density (g/ cm3) and seed index (gram/ 100 seeds) were 0.56 as well as 6.79, respectively. The result presented that the seed from okra having dimensions (width thickness, and length) were 5.37, 4. 90 as well as 4.26 mm, respectively. pH value 6.43. That the same trend was also observed by Sahooa and Srivastava (2002) and Acikgoz *et al.,* (2016) stated a length (5.29 mm), width (4.32 mm), thickness (4.53 mm).

Table 1. Physical and physicochemical analysis of seed from okra.

Characteristic	Value
Seed index (g/ 100 seeds)	6.79 ±0.24
Weight of seed (g)	0.07 ± 0.10
Seed dimensions	
Length (mm)	5. 37±0.61
Width (mm)	4.90 ±0.26
Thickness (mm)	4.26 ±0.34
Bulk density (g/ cm^3)	0.56 ±0.68
pH	6.43± 0.22

Mean values represent ± Standard Deviation values.

Chemical analysis of okra seed powder.-

The proximate analysis influenced by variety, maturity, conditions of agriculture, fertilization and variation in the procedure of analysis (Ndangui *et al.,* 2010). The proximate analysis of seeds is displayed in Table (2) the chemical analysis for moisture (10.29 %), crude protein (23.95 %), crude lipid (14.91 %), crude fiber 24.81) % in addition to content of ash (4.68 %), respectively.

The results of the proximate analysis in the current study in conformity by (Adelakun *et al*., 2009, Ndangui *et al*., 2010, Dhruve *et al*., 2015 and Habtamu *et al*., 2018)). Since, okra seed has high crude fiber content, its inclusion in diet may be beneficial as Jacob *et al*., (2015) stated that fiber decrease the existence of various cancers also, cholesterol in human body. Moreover, the result in Table (2) shows the powder having abundant amounts of phenolic complexes (34.29 mg GAE/100g) these results agreement by (Wojdylo *et al*., 2007 and Graham *et al*., 2017). Data presented that the samples possessed radical scavenging capabilities.

The data in Table (2) also, displays that of seed powder having the high ratio of antioxidant activity presence (50.43%). Results corroborate that the potential of utilize the powder as a good source for antioxidant. These results coincide with Arapitsas, (2008) and Adelakun *et al*., (2009) that noticed activity of antioxidant was 48.34%. Moreover, Adetuyi and Komalafe (2011) illustrations add powder from seed to plantain flour improved the activity of antioxidant. According to Kopjar *et al*., (2015) total phenol besides antioxidant activity statement depending on different

component that contains the existence of further compound may interfere or can be extraction together with the phenolic.

Table 2. Chemical analysis of okra seed powder

Component	Value
Moisture (%)	10.29 ±0.27
Crude Protein (%)	23.95 ±0.86
Crude lipid (%)	14.91 ±0.42
Total ash (%)	4.68±0.90
Crude fiber (%)	24.81±0.56
Total phenol content (mg GAE/100g)	34.29±0.89
Antioxidant activity (%)	50.43±0.17

Mean values represent ± Standard Deviation values.

Mineral contents of okra seed powder Some

Minerals are evaluating to be main in human food Nwofia *et al.*, (2012) and critical for mental and are important constituents of bones, tooth, besides nerve cells Soetan *et al.*, (2010).

Various mineral are displayed in Table (3). The macronutrients mineral contents as potassium and calcium were present (164.37and 87.41 mg/100g), respectively. Moreover, micronutrients mineral contents such as iron and zinc were (15.46 and 6.69 mg/100g), respectively. These results are comparable with those described by (Gopalan *et al.*, 2007, Ndangui *et al.*, 2010 and Anupam *et al.*, 2014). Jacob *et al.*, 2015) reported that the inclusion of okra seed in diet could serve as desirable alternative source of minerals.

Table 3. Some mineral contents of okra seed powder.

Element	Value (mg/ 100g)*
Macronutrients mineral contents	
Potassium (K)	164.37±0.15
Calcium (Ca)	87.41±0.80
Micronutrients mineral contents	
Iron (Fe)	15.46±0.36
Zinc (Zn)	6.69±0.14

Mean values represent ± Standard Deviation values * (mg/100g on dry weight basis)

Amino acid profile of okra seed powder

Essential amino acids (EAA) necessity be complete through food intake because of the person cannot synthesize it (Sheng *et al.*, 2010). The amino acid (AA) profile is displayed in Table (4). The data showed among that total EAA were found to be 32.34 %. The characteristic of proteins a source of AA be able to generally be evaluated by comparison with the FAO/WHO (2007). In the indication of EAA, the offer quantity Table (4) covering EAA parallel to FAO/WHO.

The major of EAA were leucine (6.71%) followed by lysine (5.22%). On the other hand, the major of non-essential amino acids were glutamic acid (16.93%) followed by aspartic acid (11.18%) and arginine (10.39%). Moreover, the data indicated that showed there other amino acids low percentage value. That results are in conformity by those described by Oyelade *et al.*, (2003) also,Sanjeet *et al.*, (2010) and Ewa *et al.*, (2011).

Chemical analysis of okra seed oil

The chemical analysis of okra seeds oil is displayed in Table (5). The crude oil had acceptable odour and liquid at ambient temperature.

However, the crude oil displayed low peroxide values as well as free fatty acids being (1.41 meqo2/Kg oil) and (1.13 as % oleic acid) showing its stability to degradation. Iodine value (110.11). Thus, oil could be categorized as a semi-dry oil as corn oils in addition to sunflower. The same trend was found by (Ndangui *et al.*, 2010andDong *et al.*, 2014). Peroxide value is an agreed index for identifying the decline of oils value in addition to values above 20 display rancid taste and unpleasant smell, the smaller level of peroxide value of seed oil illustrations less oxidative rancidity and high antioxidant of the oil (Etong *et al.*, 2014). Okra oil is comparable to that of commercial oils, so seed oil could be an important ingredient for industrial utilization (Omoniyi *et al.*, 2018).

Table 4. Amino acid profile of okra seed powder

Amino acids	%
Lysine	5.22 ±0.13
Threonine	3.10 ±0.16
Methionine	0.76 ±0.23
Valine	4.95±0.47
Isoleucine	3.34 ±0.82
Leucine	6.71±0.32
Phenylalanine	4.62±0.38
Histidine	3.64±0.54
Total Essential A.A	32.34
Serine	4.27±0.33
Proline	5.17±0.87
Glycine	5.91±0.42
Alanine	3.99±0.52
Tyrosine	2.36 ±0.91
Aspartic Acid	11.18±0.53
Glutamic Acid	16.93 ±0.27
Arginine	10.39 ±0.65
Total-Non Essential A.A	60.20

Mean values represent ± Standard Deviation values.
A.A. Amino acid

Table 5. Chemical analysis of okra seed oil

Property	Value
Peroxide value ($meqo_2$/Kg oil)	1.41±0.60
Iodine value	110.11±0.32
Free fatty acids (as % oleic acid)	1.13±0.94

Mean values represent ± Standard Deviation values.

- Fatty acid profile of okra seed oil

The fatty acid (FA) profile of oil are displayed in Table (6). The most abundant FA in oil is linoleic acid (38.35 %), followed by palmitic acid (28.98 %), oleic acid (24.38 %) in addition stearic acid (4.14 %). This displayed the major saturated FA in oil are palmitic acid also, stearic while unsaturated FA are linoleic acid and oleic acid. Moreover, the result presented slight quantities of the fatty acid oil as palmitoleic acid. The FA profile of oil found to be comparable as reported by Jarret *et al.*, (2011), Awolu *et al.*, (2014), and Topkafa (2016). The differences in the described fatty acid may be due to the differences in cultivar and maturity level of okra, oil extraction methods, methods of analysis and equipment (Omoniyi *et al.*, 2018).

Table 6. Fatty acid profile of okra seed oil (%).

Fatty acid	%
Palmitic acid ($C_{16:0}$)	28.98±0.65
Palmitoleic acid ($C_{16:1}$)	0.74±0.91
Stearic acid ($C_{18:0}$)	4.14±0.64
Oleic acid ($C_{18:1}$)	24.38±0.97
Linoleic acid ($C_{18:2}$)	38.35±0.23
Linolenic acid ($C_{18:3}$)	0.89±0.86
Behenic acid ($C_{22:0}$)	0.62±0.79
SAT	33.74
MUFA	25.12
PUFA	39.24

Mean values represent ± Standard Deviation values
Saturated fatty acids (SFA)
Monounsaturated fatty acids (MUFA)
Polyunsaturated fatty acids (PUFA)

Functional properties of okra seed powder

The results of the functional properties of powder samples for both water absorption capacity (WAC %) and oil absorption capacity (OAC %) were 225±0.61 and 68.49± 0.42%, respectively. That results are in agreement with those reported by Adejumo, (2013) and Lakshmi *et al.,* (2014). Proteins having considerable influence on the WAC of foodstuff owing to the existence of hydrophilic components like polar or charged side chains. Flours that have the ability to absorb water well and swell for improved consistency in food (high WAC) have beneficial applications in the dough, processed meats and custards (Iwuoha, 2004).

Proteins have an influence on the OAC of food matrices. The absorption of oil by protein surfaces increases the hydrophobic interaction of proteins with flavor compounds besides the binding of food to the inner walls of the mouth through chewing. Therefore, OAC of food determines the mouth-feel, flavour retention other than shelf stability of baked or fried foods and especially meat products (Adebowale *et al.*, 2005).

Sensory evaluation

The sensory evaluation quality of chicken nuggets made with or without a blend of flour are displayed in Table (7). The scores for sensory attributes, colour, odor, texture as well as overall acceptability of chicken nuggets differed significantly (P≤0.05) through the samples made with 2% (M1) and 4% replacement of chicken meat.

Nuggets samples made from (M1) recorded higher acceptability with scores 8.8 than the further samples. The sensory attributes scores were detected to be significantly higher in nuggets with (M1) as compared with control and nuggets samples (M2). Regarding to the sensory acceptance test, we can deduce it is possible to partially replace meat by powder from okra seed in chicken nuggets. The conformity of the same results by Gopalan *et al.*, (2007), Muthulakshmi, (2010) and Sanjeet *et al.*, (2010).

Table 7. Sensory evaluation of chicken nuggets.

Sample*	Colour	Odour	Texture	Overall acceptability
M	8.1±0.16 [a]	8.0±0.32 [a]	8.0±0.12 [a]	8.0±0.66 [a]
M1	8.6±0.43 [b]	8.7±0.62 [b]	8.5±0.56 [b]	8.8±0.31 [b]
M2	7.5±0.22 [c]	7.6±0.54 [c]	7.6±0.38 [c]	7.5±0.05 [c]

Mean values represent ± Standard Deviation values

Mean values with different superscripts within the same column are significantly different (p≤ 0.05)

***100% meat (M), 98% meat + 2% okra seed powder (M1), 96% meat + 4% okra seed powder (M2).**

Table (8) shows the sensory properties of the biscuit samples made from wheat flour combined with okra powder. There were significant differences (p≤ 0.05) through the samples in terms of colour, odor, texture as well as overall all acceptability. Biscuit samples (B1) that higher values of overall all acceptability 8.5 followed by biscuit samples (B2) 8.2 and also no significantly (P≤0.05) in both of them. Samples (B) and (B3) smallest rating through all the attributes evaluated and significantly (P≤0.05) in both of them. Moreover, there was panelist satisfaction of samples. Biscuit samples (B1) the biggest grade in overall acceptability. This could be assigned to the variation in the structure of the biscuit samples by combining okra powder into the products, which affects its basic characteristics and also the judgment of the panelist. Concerning to the sensory acceptance, the trial we deduce it is potential to partially substitute wheat flour by powder from okra seed in biscuit samples. Similar results were reported by Otunola *et al.*, (2007), Ilodibia *et al.*, (2017) and Mir *et al.*, (2015) for cakes by increasing non-wheat flour in the formulation.

Table 8. Sensory properties of biscuit.

Sample*	Colour	Odour	Texture	Overall acceptability
B	7.5±0.26[a]	7.6±0.21[a]	7.5±0.50[a]	7.4±0.67[a]
B1	8.6±0.51[b]	8.5±0.51[b]	8.7±0.48[b]	8.5±0.31[b]
B2	8.3±0.70[b]	8.2±0.66[b]	8.5±0.33[b]	8.2±0.75[b]
B3	6.7±0.96[c]	6.5±0.18[c]	6.6±0.66[c]	6.5±0.81[c]

Mean values represent ± Standard Deviation values

Mean values with different superscripts within the same column are significantly different (p≤ 0.05)

***100% wheat flour (B) , 95% wheat flour + 5% okra seed powder (B1), 90% wheat powder + 10% okra seed powder (B2) and 85% wheat powder + 15% okra seed powder (B3).**

CONCLUSION

Okra Seeds powder due its several health benefits can use it to applied in manufacturing for dietary improvement. The analysis revealed that powder from okra seed having high in crude protein with essential amino acids, fiber in addition to fat also, the unsaturated fatty acids are linoleic besides oleic acid, functional characteristic, total phenolic other than considerable mineral contents. In addition, sensory evaluation presented can useful application it for the fortification of several foodstuffs based on its physical in addition to chemical analysis. Furthermore, the investigation was prepared to get a detailed line the various constituent of okra seeds that possibly will be beneficial for the interest of both industrial and nutritional.

REFERENCES

Acikgoz, C., Borazan, A. A., Andoglu, E. M. and Gokdai, D. (2016). Chemical composition of turkish okra seeds (*hibiscus esculenta)* and the total phenolic content of okra seeds flour. Anadolu University Journal of Science and Technology A-Applied Sciences and Engineering, 17(5), 766-774.

Adebowale, A.A., Adegoke, M.T., Sanni, S.A., Adegunwa, M.O.and Fetuga, G.O. (2005). Functional properties and biscuit making potentials of sorghum-wheat flour composite. American Journal of Food Technology. 7: 372-379.

Adegunwa, M.O., Ganiyu, A.A., Bakare, H.A.and Adebowale A.A. (2014). Quality evaluation of composites of some product. Agriculture and Biology Journal of North America.5 (1), 33-39.

Adelakun, O.E., Oyelade, O.J., Ade-Omowaye, B.O., Adeyemi, I.A .and Van de Venter, M. (2009). Chemical composition and the antioxidative properties of Nigerian Okra seed (Abelmoschusesculentus Moench) flour. Food Chem Toxicol 2009; 47: 1123-1126.

Adejumo, B. A. (2013). Some quality attributes of locally produced wheat flour in storage. Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), 5 (2), 47-49.

Akoja, S.S. and Coker, O.J. (2018). Physicochemical, functional, pasting and sensory properties of wheat flour biscuit incorporated with Okra powder. International Journal of Food Science and Nutrition. Volume 3; Issue 5; September 2018; Page No. 64-70.

Aleem, S., Ashraf, S., Liaquat, A. and Ali, R. (2019). Evaluate of okra seeds in biscuits on the basis of its physical, chemical and sensorial analysis. Inter J Agri Biosci, 8(3): 153-156.

Anupam, R., Shanker, L. S. and Santi, M. M. (2014). Functional properties of Okra (*Abelmoschusesculentus* L.) (Moench): traditional claims and scientific evidences. Plant Science Today. 1 (3): 121-130.

Arapitsas P. (2008). Identification and quantification of polyphenolic compounds from okra seeds and skins. Food Chem., 110: 1041–1045.

Adetuyi, F. O. and Komolafe, E. A. (2011). Effect of the addition of okra seed (*Abelmoschus esculentus*) flour on the antioxidant properties of plantain Musa paradisiaca flour. Annual Review and Research in Biology, 1(4), 143-152.

AOAC. (2010). Analysis of the Association of Official Analytical Chemists (AOAC). International, William, H. (ed). 17th Ed. Gaithersburg M.D, U.S.A:Official Method.

AOCS. (1997). Official Methods and Recommended Practices of the American Oil Chemist's Society, (5 th Ed.) AOCS Press, Champaign, IL.

Awolu, O. O., Igbe, F. O. and Sanusi, A. B. (2014). Characterization and optimization of solvent and enzymatic extraction of okra (*Abelmoschus esculentus*) oil. Journal of Scientific Research and Reports. 3(4), 630-638.

Calisir, S., Ozcan, M., Haciseferogullari, H.and Yildiz, M.U. (2005). A study on some Physico-chemical properties of Turkey okra (*Hibiscus esculenta*) seeds. Journal of Food Engineering, 68, 73–78.

Chinma, C.E., James, S., Imam, H., Ocheme, O.B., Anuonye, J. C.and Yakubu, C.M. (2011). Physicochemical and sensory properties and in-vitro Digestibility of biscuits made from blends of tigernut (*Cyperus esculentus*) and pigeon pea (*Cajanus cajan*). Nigerian Journal of Nutritional Sciences. (32), 55-62.

Dhruve, J. J., Shukla, Y. M., Shah, R., Patel, J. and Talati, J. G. (2015). Contribution of okra (*Abelmoschus esculentus* L.) seeds towards the nutritional characterization. World Journal of Pharmacy and Pharmaceutical Sciences, 4(7), 1009-1023.

Dong, Z., Zhang, J. G., Tian, K. W., Pan, W.J. and Wei, Z. J. (2014). The fatty oil from okra seed supercritical carbon dioxide extraction composition and antioxidant activity. Current Topics in Nutraceutical Research, 12(3), 75-84.

Etong, D. I., Mustapha, A. O. and Taleat, A. A. (2014). Physicochemical Properties and Fatty acid composition of Dikanut (*Irvingia gabonensis*) seed oil. Research Journal of Chemical Sciences. (4)(12), 70-74.

Ewa, C., Agnieszka, G. and Adametal, F. (2011). The content of protein and of amino acids in Jerusalem artichoke tubers (*Helianthus tuberosus* L) of red variety Rote Zonenkugel Acta Scientiarum Polonorum, Technologia Alimentaria 10:433-441.

Eze, J.I. and Akubor, P.I. (2012) Effect of drying methods and storage on the physicochemical properties of okra. J Food Process Techno 3:177.

FAO/WHO, (2007). Protein and amino acid requirements in human nutrition. Report of a Joint WHO/FAO/UNU Expert Consultation, WHO technical report series no. 935. Geneva, Switzerland, World Health Organization.

Fogliano, V., Verd, V., Randazzo, G. and Ritieni, A. (1999). Method for measuring antioxidant activity and its application to monitoring the antioxidant capacity wines. Journal of Agricultural and Food Chemistry, 47: 1035 –1040.

Folch, J., Lees, M. and Sloane-Stanley, G. H. (1957). A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological Chemistry, 226(1): 497-509.

Gbadegesin, A.R., Odunlade, T. V. and Otunola, E. T. (2018). Nutritive and sensory properties of okra fortified instant fufu. International Food Research Journal 25(3): 1031-1035.

Gemede, H.F., Ratta N., Haki, G.D., Beyene, F., Woldegiorgis, A.Z. and Rakshit, S.K. (2016). Proximate, mineral, and anti-nutrient compositions of indigenous okra (*Abelmoschus esculentus*) pod accessions: implications for mineral bioavailability. Food Science & Nutrition.; 4(2): 223–233.

Goplana, C., Sastri, S.B., and Balasubramanian, S. (2007). Nutritive value of Indian foods. National Institute of Nutrition (NIN), ICMR, India, 1(2), 49-54

Graham, J.O., Agbenorhevi, J.K.and Kpodo, F.M. (2017). Total phenol content and antioxidant activity of okra seeds from different genotypes. American Journal of Food and Nutrition. 5, (3), 90-94.

Habtamu, F.G., Haki, G.D., Fekadu, B., Rakshit, S.K. and Ashagrie, Z.W. (2018). Nutritional and ant nutritional evaluation of indigenous Ethiopian okra (*abelmoschus esculentus*) seed accessions. Afr. J. Food Agric. Nutr. Dev. 18(1): 13019-13033.

Hagerman, A.E. and Butler, L.G. (1978). Protein precipitation method for the quantitative determination of tannins. Journal of Agricultural and Food Chemistry, 26: 809 – 812.

IFT, (1981). *Institute of Food Technologists* (*IFT*) Sensory evaluation guideline for testing food and beverage products. Food Technology, 35: 50-59.

Ilodibia, C.V., Achebe, U.A. and Chiafor, C. (2017). Nutrient characteristics assessment of two variants of okra (Abelmoschus esculentus L Moench.) found in Anambra State, Nigeria. Archives of Agriculture and Environmental Science 2(4), 298-300.

Iwuoha, C. I. (2004), Comparative evaluation of physicochemical qualities of flours from steam-processed yam tubers, Food Chemistry, 85, 541–551.

Jacob, A. G., Etong, D. I. and Tijjani, A. (2015). Proximate, mineral and anti-nutritional compositions of melon (*Citrullus lanatus*) seeds .British Journal of Research, 2(5), 142-151.

Jarret, R. L., Wang, M. L.and Levy, I. J. (2011). Seed oil and fatty acid content in okra (*Abelmoschus esculentus*) and related species. Journal of Agricultural and Food Chemistry, 59:4019–4024.

Kopjar, M., Tadic, M. and Pilizota, V. (2015). Phenol content and antioxidant activity of green, yellow and black tea leaves. Chemical and Biological Technologies in Agriculture, 2(1): 1-6.

Lakshmi, M., Swarnali, D.M.and Usha, R. (2014). Mango (*Mangifera indica* L) kernel flour as a potential ingredient in the development of composite flour bread. Indian Journal of Natural Products and Resources. 2014; 5(1):75-82.

Minh, N.P, Bach, L.G., Chau, M.H., Loan, L.Y., Tram, V.B. and Truyen, T.V. (2019). Production of dried tea from okra (*Abelmoschus Esculentus*). J. Pharm. Sci. and Res., 11(2), 279-283.

Mir, N.A., Gul, K. and Riar, C.S. (2015). Techno-functional and nutritional characterization of gluten-free cakes prepared from water chestnut flours and hydrocolloids. Journal of Food Processing and Preservation. 39:978-984.

Mujumdar, A. S. (1995). Handbook of industrial drying (second Ed.). New York: Marcel, Dekker.

Muthulakshmi, M. (2010). Role and limitations of non-meat ingredients in processed meat products Training manual on Requirements and developments in processed meat sector for better utilization of meat animal resources .NRC Hyderabad, p52-57.

Ndangui, C.B., Kimbonguila, A., Nzikou, J.M., Matos, L. and Pambou, N.P. (2010).

Nutritive composition and properties physico-chemical of gumbo (*Abelmoschus esculentus* L.) seed and oil. Research Journal of Environmental and Earth Sciences 2(1) 49-54.

Nwofia, G.E., Nwogu, N. and Nwofia, K. (2012).Nutritional variation in fruits and seeds of pumpkins (*cucurbita spp*) accessions from Nigeria. Pakistan Journal of Nutrition. 11(10): 946-956.

Omoniyi, S.A., Idowu, M. A.and Adeola, A. A. (2018). Potential domestic and industrial utilizations of okra seed: a review. Annals. Food Science and Technology. (19), (4), 722-730.

Otunola, E.T., Sunny-Roberts, E.O. and Solademi, A.O. (2007). Influence of the addition of okra seed flour on the properties of 'Ogi', a Nigerian fermented maize food. Conference on International Agricultural Research for Development, University of Kassel Witzenhausen and University of Gottingen, 9-11 October

Oyelade, O.J., Ade-Omowaye, B.I.and Adeomi, V.F. (2003). Influence of variety on protein, fat contents and some physical characteristics of okra seeds. Food Chem., 57: 111-114.

Radwan, S. S. (1978). Coupling of two-dimensional thin-layer chromatography with gas chromatography for the quantitative analysis of lipid classes and their constituent fatty acids. Journal of Chromatographic Science, 16(11), 538-542.

Petropoulos, S., Fernandes, A. Barros, L.and Ferreira, I. (2018). Chemical composition, nutritional value and antioxidant properties of Mediterranean okra genotypes in relation to harvest stage. Food Chemistry 242 , 466–474.

Sahooa, P. K. and Srivastava, A. P. (2002). Physical properties of okra seed. Biosystems Engineering, 83(4), 441-448.

Sanchez-Alonso, I., Jemenez-Escrig, A., Saura-Calixto, F. and Borderais, A.J. (2007). Effect of grape antioxidant dietary fiber on the prevention of lipid oxidation in minced fish: Evaluation by different methodologies. Food Chemistry, 101: 372-378.

Sanjeet, K., Skona, D., Adamou, H., Alain, R., Dov, P. and Christophe, K. (2010). Okra (*Abelmoschus spp*.) in west and central Africa: potential and progress on its improvement. African Journal of Agricultural Research. Vol. 5(25) , 3590-3598.

Sheng, Z., W., Ma, Z., Jin, Y. B, Sun, H., Dou, J., Gao, J. L. and Han, L.(2010). Investigation of dietary fiber, protein, vitamin E and other nutritional compounds of banana flower of two cultivars grown in China. Afr. J. Biotech., 9(25): 3888-3895.

Soetan, K.O., Olaiya, C.O. and Oyewole, O.E. (2010).The importance of mineral elements for humans, domestic animals and plants: A review. Afr. J. Food Sci., (4), 200-222.

Spackman, D.H., Stein, E.H. and Moore, S. (1958). Automatic recording apparatus for use in the chromatography of amino acids. Analytical Chemistry,30:1190-1191.

Steel, R.G. and Torrie.J.H. (1980). Principles and procedures of statistics 2 nd ed. McGraw Hill, New York, U.S.A.

Topkafa, M. (2016). Evaluation of chemical properties for cold pressed onion, okra, rosehip safflower and carrot seed oils: triglyceride, fatty acid and tocol compositions. Analytical methods. (8), 4220-4225.

Wojdylo, A., Oszmianski, J., and Czemerys, R. (2007). Antioxidant Activity and Phenolic Compounds in 32 Selected Herbs. Food Chemistry, 105(3): 940-949.

تدعيم بعض المواد الغذائية باستخدام مطحون بذور البامية بناءًا على التقييم الكيميائي والحسي

أيمن محمد أبواليزيد

قسم علوم الاغذيه – كليه الزراعه سابا باشا – جامعه الاسكندريه

تم استخدام مطحون بذورالبامية (*Abelmoschus esculentus* L) الجافة لتقييم الخصائص الطبيعيه والتحليل الكيميائي لتدعيم الأغذيه. وشملت التحاليل الرقم الهيدروجيني ، الكثافة الظاهرية (جم / سم 3) ، البروتين الخام (٪) ، الألياف الخام (٪) ، إجمالي المواد الفينوليه (mg GAE/100g) و نشاط مضادات الأكسدة وكانت النتائج كالاتي: (٪) ، 6.43 ، 0.56 ، 23.95 ، 24.81 ، 34.29 ، 50.43 ، على التوالي. علاوة على ذلك وجدت محتويات معدنية مناسبه. اظهر تحليل الأحماض الأمينية الأساسية (EAA) ارتفاع الليوسين بين (6.71 ٪) ويليه ليسين (5.22 ٪). بينما أكثر الأحماض الدهنية وفرة في زيت بذور الباميه هو حمض اللينوليك (38.35 ٪) ، يليه حمض حمض البالمتيك (28.98 ٪) ، وحمض الأوليك (24.38 ٪) ، وكذلك حامض الاستياريك (4.14 ٪). بالإضافة إلى رقم البيروكسيد و الأحماض الدهنية الحرة (1.41 meqo$_2$/Kg oil) و (1.13 كنسبة حمض أوليك) علي التوالي. مما يشير ذلك إلى الثبات العالي وتاخير التدهور. بالإضافة إلى ذلك ، اظهر التقييم الحسي القبول بدرجه عاليه للاغذيه المدعمه ممايشير بشكل مفيد إمكانيه التدعيم العديد من المواد الغذائية على أساس الخصائص الطبيعيه والكيميائي. علاوة على ذلك ، تم توفير المعلومات للعديد من مكونات بذور البامية و التي قد تكون مفيدة من الناحيه الصناعية والغذائية.