Effect of Addition of Doum Fruits Powder on Chemical, Rheological and Nutritional Properties of Toast Bread

El-Hadidy. G. S.[1] and El-Dreny, E. G.[2]
[1]Bread and Pasta. Dep., Food Tech. Res. Inst., Agric. Res. Center, Egypt.
[2]Special Food and Nutrition Dep., Food Tech. Res. Inst., Agric. Res. Center. Egypt

Abstract

The aim of study to produce high quality, nutritional value, sensory and rheological properties toast bread from doum fruit powder DFP and wheat flour WF.
Four toast were prepared; by substituting wheat flour with0, 10, 20 and 30% by doum fruit powder (DFP). The chemical, caloric value, physical and sensory properties of toast bread were studied. The results showed that addition of DFP to WF at different proportion due to an increase in water absorption (%), dough softening (B.U), dough development (min) and water holding capacity. Meanwhile, extensibility(mm) decreased in all doughs of DFP (10, 20 and 30%). Energy was decreased by addition of DFP at levels of 20 and 30% of DFP were (15 and 20 cm^2), respectively. The results showed that increasing the levels of replacement increased ether extract, ash and crude fiber contents in prepared toast bread compared with control. Minerals of the prepared toast bread showed an increased in Ca, K, Mg and Fe while slightly decreased in P and Mn with increasing the proportions of replacement. The sensory evaluation results showed a significantly increase in the taste, odor, crumb grain and crumb texture by increasing the DFP substitution comparing with control. Meanwhile, crust color, appearance and overall acceptability decreased than control.

Keywords: *Hyphaene thebaica*, Bread, Toast, Farinograph, Extentsograph.

Introduction

In developing functional bakery products (such as bread), it is essential to change a produce with physiological effectiveness and consumer's acceptance in terms of texture, appearance and taste [1]. Bread is an important staple food made of wheat flour, yeast and salt and consumed around world [2]. Nowadays people prefer to eat healthier food in order to prevent non-communicable diseases. For this purpose, industry and researchers are involved in optimizing bread making technology to improve the quality, taste, variety and availability of food products such as bread [3]. Among the ingredients that could be included in bread formulation there are spices and herbs, which are important part of the human food. They have been used for thousands of years to enhance the odor, aroma and color of food and also for

their antimicrobial, anti-oxidative, preservative and other medicinal values. For example, [4] preparing gluten free biscuits and flat bread with high quality for celiac patients. Wheat (*Triticum aestivum*) is main of the essential edible grains around the world [5]. It is used in many forms consist of flat or pan style leavened bread. Wheat is depression in indispensable amino acids, for example, lysine and methionine, which reduces its nutritious value when utilization in foods products [6].

Doum (*Hyphaene thebaica* L.) is one of the palm trees grow in Africa in Sudan and Egypt along the Nile. Trees are used in manufacturing and fruits in human feeding [7]. Nutritionally, Doum fruits is an important source of fiber and minerals including phosphorus, calcium, sodium, magnesium, potassium. Additionally, micronutrients such as vitamins (especially B vitamins) also help to regulate the biological processes in the body and impart health benefits [8]. Numerous studies have proven that the doum fruits contain high level of flavonoids, phenols and antimicrobial activities and possess significant antioxidant [9].

The doum fruits are comparatively source of essential minerals and proteins. The doum contains more essential mineral elements than a person's daily need. Thus, a balance may occur in the body's needs for mineral elements [10]. When conducting biological experiments on experimental rats, it was found that blood pressure lowering by consuming doum [11]. [12] stated that proportion of Na/K is less than one, this is beneficial for blood pressure patients.

Recently, researchers focused on studying dietary fiber because of its nutritional and health importance on the human body, as the fiber works to reduce the symptoms of some diseases such as hypercholestero, cardiovascular disease, hypoglycemic, some forms of cancer and also health promotion of consumers through a reduction in fat and cholesterol, As a result of the high doum content of fiber to add to the industry of many bakery goods, such as bread, cakes, cookies and biscuits to producing products rich in fiber acceptable to the sensory attributes properties of the consumer [13].

This study was conducted to use DFP as a functional food and as a high source of fiber in toast bread preparing and to estimate the impact of fortified of wheat flour (82% extraction) with the DFP on chemical, sensory properties of toast bread and rheological properties of dough.

Material and Methods

Materials

The doum fruits (*Hyphaene thebaica* L.) were purchased from local market in Luxor, Egypt. WF (82% extraction), sugar (sucrose), vegetable shortening, instant active dry yeast and salt (sodium chloride) were collected from the market at Kafrelsheikh city, Egypt. All chemicals purchased from El- Gamhouria Trading Chemicals and Drugs Company, Egypt.

Doum fruits powder preparation

DF were milled electrically in laboratory mill (JKA-Labora technic, Janke and Kunkel Type: MFC, Germany) to pass through 80 mesh sieve, then packed and kept in a refrigerator (4˚C) until used.

Chemical analysis

The chemical analysis comprises i.e. crude protein, ash, ether extract and crude fiber of raw materials and toast bread blends were estimated according to [14]. Total carbohydrates content was calculated by difference as reported by [15]. The energy value (on dry weight basis) was calculate using the Atwater formula as:

Caloric value = (ether extract × 9) +(protein × 4) + (carbohydrates ×4). The energy value was estimated according to **[16]**.

Determination of minerals content

Minerals were determined according to the methods of [14]**.**

Toast bread processing:

Toast bread is prepared according to the method [17] with some modifications such as added 24g of fresh egg and sugar (sucrose) to all blends. The baking formula was 100g of flour,1.5g of yeast, 2g of salt ,3g of vegetable shortening, 5g of sugar, and water as needed. DFP as partially substitute for wheat flour at different levels (10, 20, and 30 %) in Table 1. The flour mixture is kneaded in the perineum until the homogeneity is complete. Then leave the dough for fermentation for 90 min, then put it in a toast mold, then leave it for another 90 min to ferment, finally it baked in the oven at 250°C, for 30 min.

Table 1. Toast formula prepared with DFP at different ratios of substitutions.

Ingredients	Control1	Blend 2	Blend 3	Blend 4
WF(82%ext)	100	90	80	70
DFP(%)	0	10	20	30
Yeast(g)	1.5	1.5	1.5	1.5
Salt(g)	2	2	2	2
Butter(g)	3	3	3	3
Sugar(g)	5	5	5	5
Fresh egg(g)	24	24	24	24

Rheological properties of WF and WF-DFP dough

Farinograph properties of WF and WF-DFP dough:

The farinograph test was performed to estimate water absorption, arrival time, stability time, dough development time, degree of softening (B.U) of WF and WF-DFP blends according to the method described by [18].

Extensograph properties of WF and WF-DFP dough:

[18] Method was used to estimate the extensor test on WF-DFP for studying flour blends extensibility, proportional number, elasticity and energy**.**

Sensory evaluation of toast bread

Twenty panelists from the staff of Sakha food Technology Research Laboratory., Agric. Res. Center. Egypt. were asked for sensory evaluation of toast bread taste, crust color, odor, crumb grain, crumb texture, appearance and overall acceptability according to the method described by [19]. Panelists evaluated pan bread blends on a 9 point hedonic scale quality analysis with 9 = liked extremely, 8 = liked very much, 7 = liked, 6 = liked mildly, 5 = neither liked nor disliked, 4 =disliked mildly, 3 = disliked, 2 = disliked very much and 1 = disliked extremely according to the method described by [20].

Statistical Analysis:

Statistical analysis was done using SPSS software (version 15) and Duncan's multiple range tests was used for mean comparison.

Results and Discussion

Chemical composition of WF 82%extraction and DFP (g /100g on dry weight basis).

The mean value of crude protein, crude ether extract, ash, fiber, total carbohydrates, available carbohydrates and caloric values (kcal/100g) are shown in Table 2. The results indicate that the crude protein, available carbohydrates and total carbohydrate contents in the DFP is less than wheat flour, whereas the doum content of crude fiber, crude ether extract and ash is higher than wheat flour. These results are consistent with [21] stated that DFP contain 5.68 % protein, 6.80 % fat, 24.30 % crude fiber and available carbohydrates 46.20 %, respectively.

Table 2: Chemical composition of WF 82% and DFP (g /100g on dry weigh basis)

Raw materials	WF	DFP
Crude protein	12.60±0.22	7.00±0.11
Ether extract	1.80±0.15	6.33±0.22
Ash	1.47±0.01	6.79±0.02
Total carbohydrates	84.13±0.55	79.88±0.24
Crude fiber	1.50±0.01	25.00±0.11
Available carbohydrates	82.63±0.75	54.88±0.95

Caloric value (kcal/100g)	397.12±3.22	304.49±2.55

WF: Wheat flour; DFP: Doum Fruit Powder

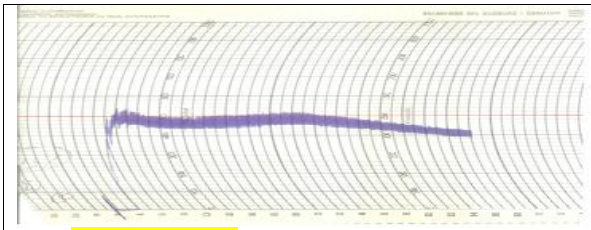
Total carbohydrates =Crude fiber + Available carbohydrates

Farinograph parameters of prepared WF and WF-DFP toast bread dough

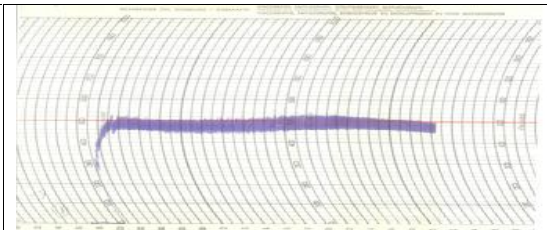
Rheological properties of dough formula made from different levels of DFP were determined by farinograph tests and the results were presented in Table (3), Fig. (1). Increased absorption of dough with water due to the high percentage of fibers in the DFP. As the fibers have the ability water holding capacity as reported by [22] and [23]. With regarded to the arrival time, dough development time and dough stability values were directly affected by the addition of DFP ratios. Dough with 30% DFP was the highest arrival time and development time values as (4.00 and 5.00min), respectively. Similar findings were mentioned by [22] and [23]. They mentioned that arrival time and water absorption increment as DFP level increased in dough. Dough stability values were found to be higher in toast dough prepared by 30% DFP than the control dough, while dough softening value increased for all doughs of fortified with DFP samples as comparing to the control. This may also be due to the fibers that interacts with the gluten, which affects the dough mixing properties [24].

Table 3: Farinograph parameters for WF and WF-DFP dough.

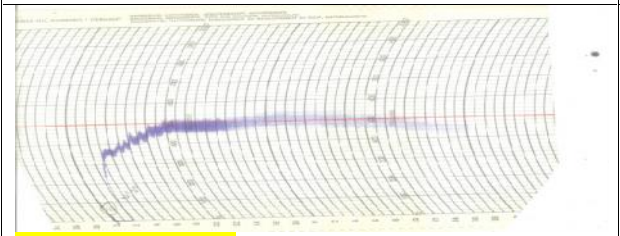
Samples	Water absorption (%)	Arrival time (min)	development Dough (min)	Stability (min)	Degree of softening (B.U)
Control	60.0 ±0.23	1.0 ±0.02	1.5 ±0.06	12 ±0.30	10 ±0.05
Doum 10%	63.0 ±0.25	1.0 ±0.01	1.5 ±0.08	10.0 ±.0.33	60 ±0.55
Doum 20%	66.0 ±0.22	2.0 ±0.04	2.5 ±0. 10	12.0 ±0.32	40 ±0.85
Doum30%	68.8 ±0.27	4.0 ±0.05	5.0 ±0.20	13.0 ±0.23	30 ±0.75



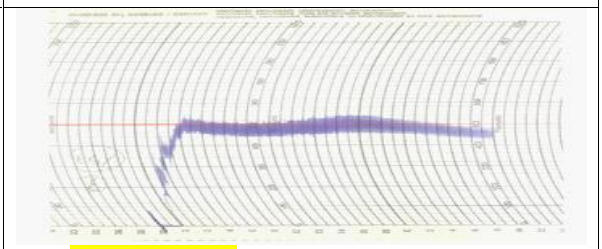
10% WF-DFP dough



WF control



30% WF-DFP dough



20% WF-DFP dough

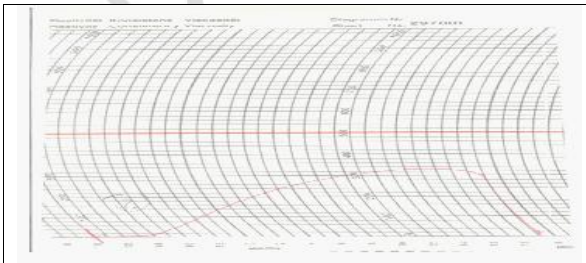
Fig. 1: Rheological properties WF and WF-DEP dough by farinograph

Extensograph parameters of WF and WF-DFP dough

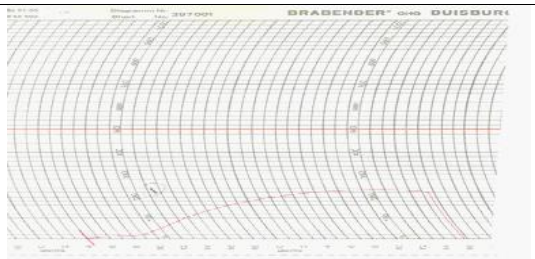
Data presented in Table (4) and Figure (2) show that the effect of adding doum fruit powder DFP at three ratios on the rheological properties of dough as evaluated by a extensograph. elasticity (B.U) and Proportional increased as DFP ratios increased of dough toast processed DFP. Meanwhile, extensibility(mm) was 140 mm in control dough and decreased in all doughs of DFP (10, 20 and 30%).Also, the proportion 10% substitution of wheat flour by DFP induced an increase in energy to (38 cm^2) comparing with control dough (35 cm^2). Energy was decreased by addition of DFP at levels of 20 and 30% of DFP were (15 and 20 cm^2), respectively.

Table 4: Extensograph properties of WF and WF-DFP dough

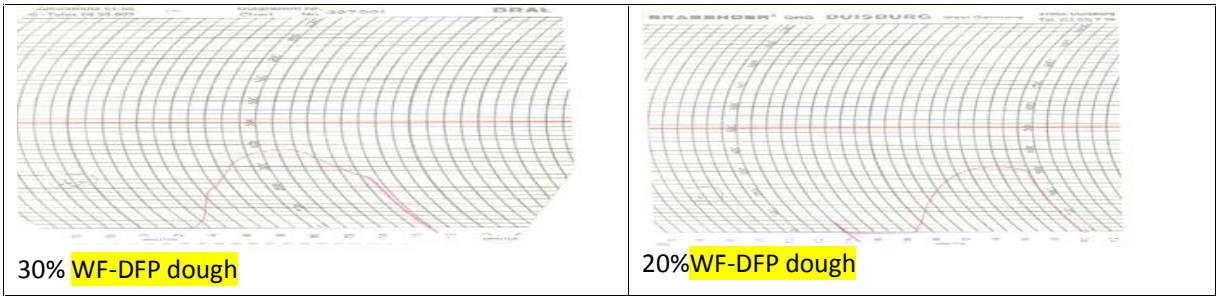
Dough properties	Elasticity (B.U)	Extensibility (min)	Proportional number	Energy (cm^2)
Control	230 ±1.50	140 ±0.85	1.64 ±0.06	35 ±0.44
Doum 10%	330 ±2.30	130 ±0.75	2.53 ±0.05	38 ±0.32
Doum 20%	320 ±2.70	90 ±0.65	3.55 ±0.04	15 ±0.20
Doum30%	380 ±2.33	75 ±0.95	5.06 ±0.08	20 ±0.22



10% WF-DFP dough



WF control



30% WF-DFP dough

20%WF-DFP dough

Fig. 2: Rheological properties of WF and WF-DFP dough by extensogragh

Chemical composition of prepared WF and WF-DFP composite toast bread (g /100g on dry weight basis)

Table 5 showed the mean value content of crude protein, crude ether extract, ash, crude fiber and total carbohydrates of the produced toast bread fortified with 10%, 20% and 30% of DFP. Crude fiber, total fat and ash increased significant in toast bread fortified with DFP compared with control. while there was a decrease crude protein, available carbohydrates caloric value and total carbohydrates. This may be due to increased amount of crude fiber, total fat and ash in DFP compared with WF. This clearly indicates that DFP can be an alternative source of dietary fiber in toast bread processing. This study is consistent with hose obtained by [23] cleared that DFP cake decrease in protein and total carbohydrates. On the other hand, cake made from DFP cake increase in ash, crude fiber and ether extract.

Table 5: Chemical composition of prepared WF and WF-DFP composite toast bread (g / 100g on dry weight basis)

Samples	Crude protein	Ether extract	Ash	Total carbohydrate	Crude fiber	Available carbohydrate	Caloric value
Control	13.50^{a}±0.02	3.80^{d}±0.10	1.65^{d}±0.03	81.05^{d}±0.03	1.50^{d}±0.02	79.55^{a}±0.77	406.40^{a}±0.44
DFP 10%	13.04^{b}±0.01	4.25^{c}±0.03	2.03^{c}±0.06	80.68^{c}±0.06	3.85^{c}±0.02	76.83^{b}±0.23	397.73^{b}±0.35
DFP 20%	12.48^{c}±0.08	4.71^{b}±0.01	2.54^{b}±0.04	80.27^{b}±0.04	6.20^{b}±0.01	74.07^{c}±0.44	388.59^{c}±0.25
DFP 30%	11.92^{d}±0.03	5.16^{a}±0.06	3.07^{a}±0.07	79.85^{a}±0.01	8.55^{a}±0.05	71.30^{d}±0.55	379.32^{c}±0.35

-a, b, c…..Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).

- Each value was an average of three determinations ± standard deviation.

- T.C = Total carbohydrates -Caloric value= (kcal/100g). - A C = Available carbohydrates

Mineral contents in WF and WF-DFP toast bread.

The data in Fig 3 and 4 show that content of major and minor mineral elements of control toast without DFP and WF- DFP toast bread. It is clear from the study that toast bread enriched with the DFP contain a highly content of potassium (K), sodium (Na), calcium (Ca), magnesium (Mg) and iron compare with control. The data show a decrease in elements phosphorus (P), zinc(Zn) and manganese (Mn) compared with control. It is clear from the results that the toast bread content of mineral elements depends content toast bread of DFP. The DFP are comparatively source of essential minerals. The DFP contains more essential mineral elements than a person's daily need. These minerals are similarly indispensable, but trace minerals are desirable in minor amounts than major minerals. The amounts wanted to the human are not an indication of their importance. The biochemical functions of micro elements seem to be as constituents of prosthetic groups or as cofactors for enzymes. Deficiency syndromes for numerous of the indispensable trace elements were not recognized until recently because of their extremely small supplies and because of the ubiquitous nature of these elements in foods

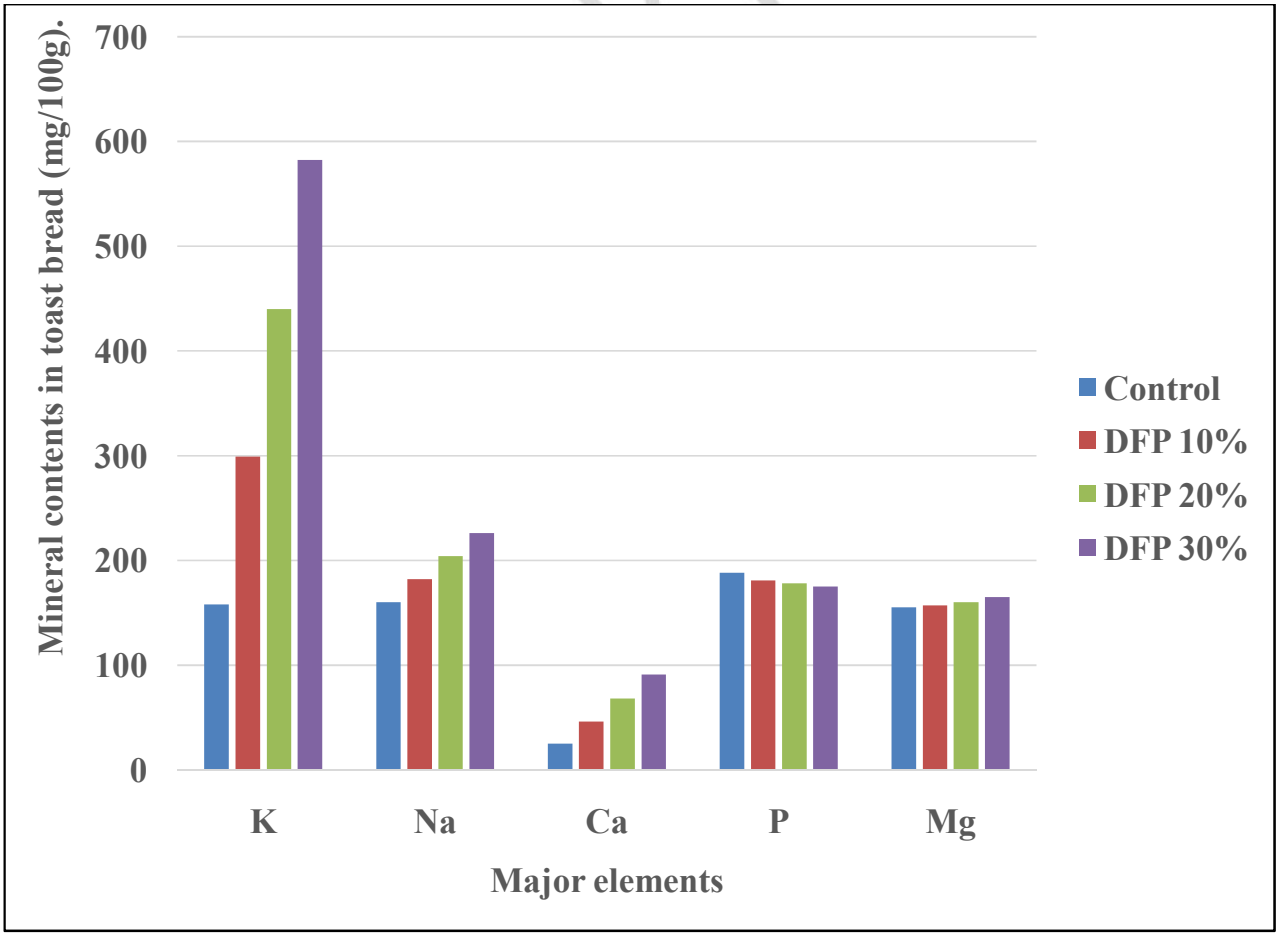


Fig. 3: The major mineral contents in WF and WF-DFP toast bread (mg/100g)

[25] stated that magnesium is essential for the activation of more than 300 enzymes in the body. Also, beneficial for the use of some minerals and vitamins and necessary for normal function and building of the heart, arteries, bone kidney, and for the neuromuscular system.

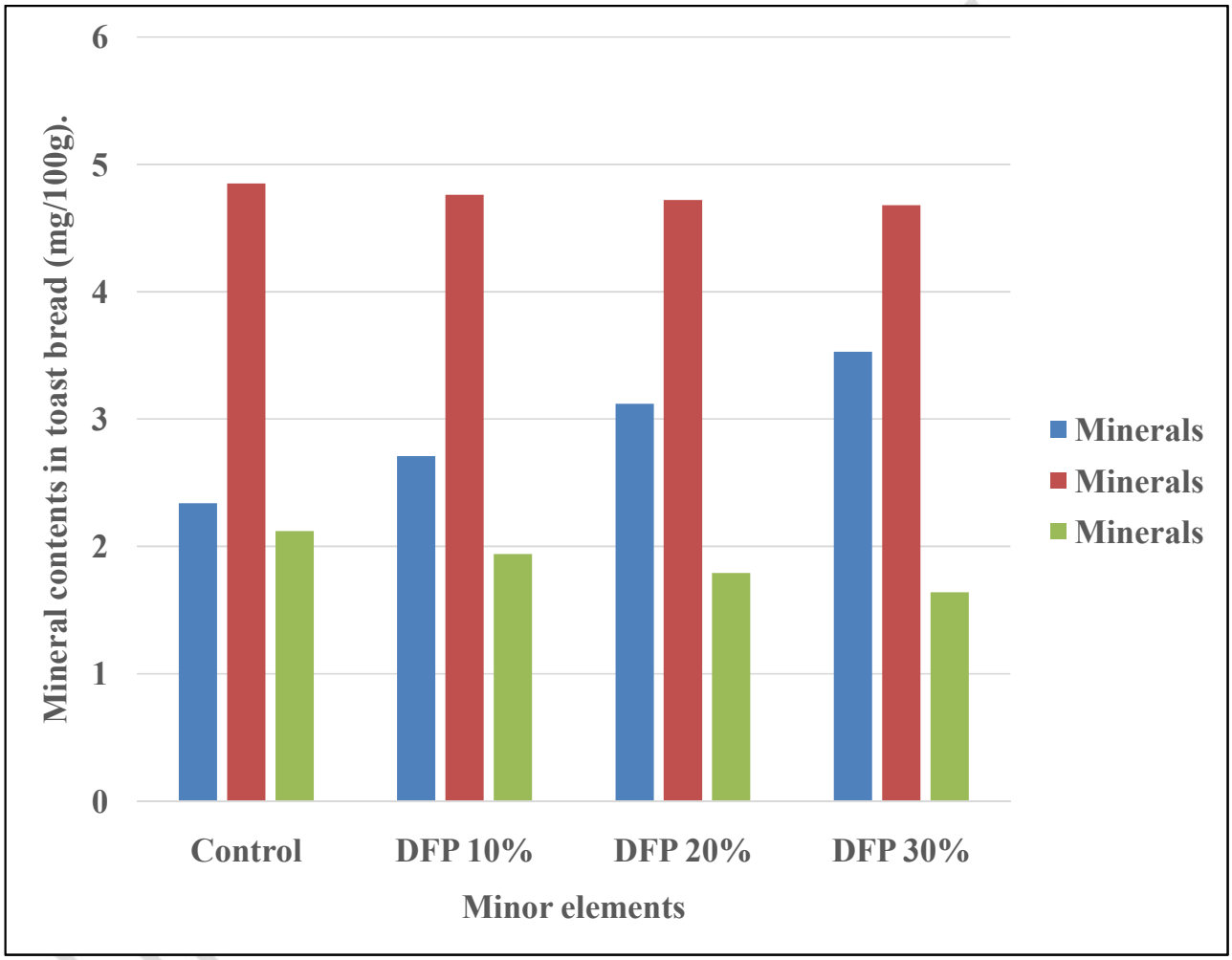


Fig. 4: The minor mineral contents in WF and WF-DFP toast bread (mg/100g)

The Na/k ratio of prepared WF and WF-DFP toast bread

Fig 5 record The Na/K ratio of prepare WF and WF-DFP toast bread process different level of DFP. The Na/K ratio of WF-DFP has highly in comparative with toast bread without of DFP. The Na/K ratio less than one with increasing the levels of substitution (10%, 20% and 20%) of DFP toast bread. These results agree with

[12] illustrated that Na/K ratio less than one have a great importance in the body for high blood pressure

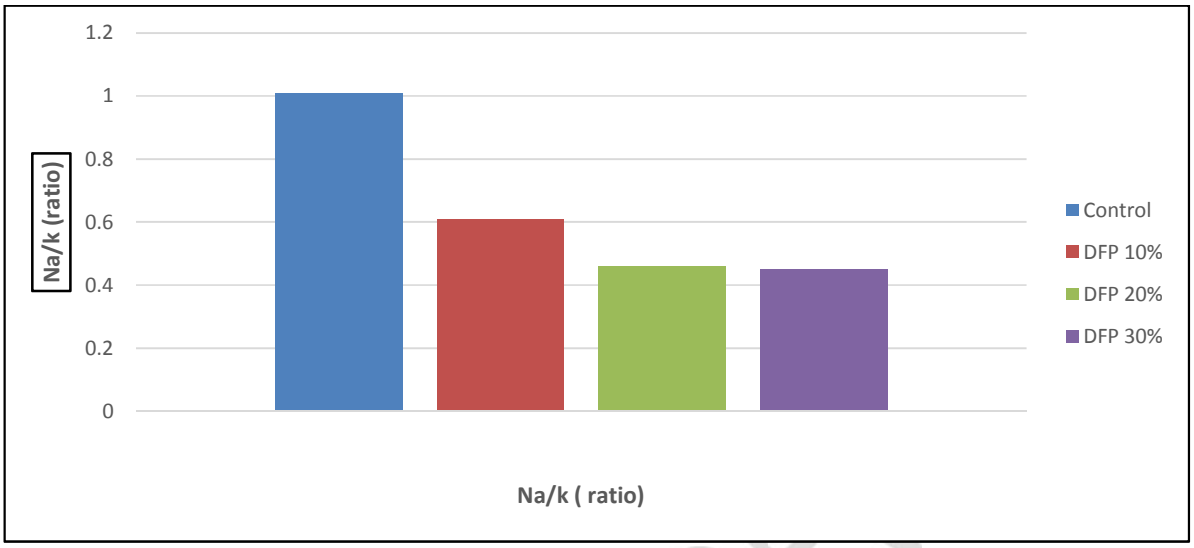


Fig. 5: The Na/K ratio contents in WF and WF-DFP toast bread (mg/100g)

Sensory Evaluation of WF and WF-DFP toast bread

Table 6 and fig 6 illustrates that the sensory properties of toast bread processed WF (82%extraction) only as a control and the toast bread prepared WF-DFP. The results indicate that the taste, odor, crumb grain and crumb texture value were increases with the increase in the percentage of DFP in toast bread. Meanwhile, other value decreases in crust color samples compared with control. Also, the appearance increased at the level of the addition of 10%DFP and then decreases at the level of 20%or30% DFP-toast bread compared to the control. Data showed an increasing the acceptability in control of toast bread than blends 10, 20 or 30% of DFP substituted toast were decrease. These results are in agreement with [22] and [23].

Table 6: Organoleptic properties of WF and WF-DFP toast bread.

Samples	Taste	Crust color	Odor	Crumb grain	Crumb texture	Appearance	Overall acceptability
Control	$8.00^{b}\pm0.40$	$8.50^{ab}\pm0.50$	$7.33^{b}\pm0.58$	$8.00^{d}\pm0.20$	$8.00^{d}\pm0.14$	$7.70^{a}\pm0.25$	$8.00^{a}\pm1.00$
10%DFP	$8.30^{b}\pm0.30$	$8.17^{ab}\pm0.29$	$7.7^{b}\pm0.57$	$8.50^{c}\pm0.38$	$8.33^{c}\pm0.33$	$8.33^{a}\pm0.58$	$7.33^{ab}\pm0.60$
20% DFP	$8.23^{b}\pm0.25$	$7.66^{ab}\pm0.58$	$8.7^{b}\pm0.23$	$8.80^{b}\pm0.28$	$8.90^{b}\pm0.33$	$7.33^{b}\pm0.57$	$7.00^{ab}\pm0.00$
30%DFP	$9.00^{a}\pm0.00$	$7.33^{b}\pm0.58$	$9.00^{a}\pm0.00$	$9.00^{a}\pm0.23$	$9.00^{a}\pm0.33$	$7.16^{b}\pm0.29$	$6.50^{b}\pm0.50$

-a, b, c…. Values followed by the same letter in columns are not significantly different at LSD at $(p \leq 0.05)$.
- Each value was an average of three determinations ± standard deviation.
-The sensory scores (9 point hedonic scale) of toast bread

Fig. 6: Control and WF-DFP toast bread.

Conclusion

The obtained results in this study revealed that toast bread were prepared using wheat flour enriched with DFP powder at different levels. The final products were rich of crude fiber, ash and minerals with low caloric value. These products were a rich source of minerals. Supplemented toast bread had lower energy value with decrease energy portions coming from fiber. The applied technological procedure using well blended combination of supplements resulted in production of toast bread its excellent rheological and sensory properties of taste, odor, crumb grain and crumb texture. Meanwhile, crust color, appearance and overall acceptability

decreased than control. Finally, it could prepare some bakery products using materials such as doum fruit powder with high quality that are suitable for consumers.

REFERENCES

1. **Siró, I., Kápolna, E., Kápolna, B. and Lugasi, A. (2008).** Functional food. Product development, marketing and consumer acceptance-a review. Appetite, 51(3),456-467.
2. **Fan, L., Yu, S., Zhang, L. and Ma, L. (2006)**. Evaluation of antioxidant property and quality of breads containing Auricularia auricula polysaccharide flour. Food Chem., 101(3): 1158-1163.
3. **Hathorn, C. S., Biswas, M. A., Gichuhi, P. N., and Bovell-Benjamin, A. C. (2008)**. Comparison of chemical, physical, micro-structural, and microbial properties of breads supplemented with sweet potato flour and high-gluten dough enhancers. LWT - Food Sci. and Technology, 41(5): 803-815.
4. **El-Dreny, E. G. and El-Hadidy, G. S. (2020)**. Preparation of Functional Foods Free of Gluten for Celiac Disease Patients. J. Sus. Agric. Sci. Vol. 46, No. 1. pp 13- 24
5. **Alu'datt, M., Rababah, T., Ereifej, K., Alli, I., Alrababah, M., Almajwal, A., Masadeh, N. and Alhamad, M. (2012**). Effects of barley flour and barley protein isolate on chemical, functional, nutritional and biological properties of pita bread. Food Hydrocolloids *26*, 135–143.
6. **Newman, C.W. and Newman, R.K. (2006).** A brief history of barley foods. J. Cereal Foods World 51, 4–7.
7. **Elnasri, N. A., Elsheik, M. A. and Eltayeb, M. A. (2013)**. Physico-chemical characterization and freundlich isotherm studies of adsorption of Fe (II), from aqueous solution by using activated carbon prepared from doum fruit waste. Arch Appl Sci Res, 5(5):149–158.
8. **Aboshora, W., Lianfu, Z., Dahir, M., Gasmalla, M. A., Musa, A., Omer, E. and Thapa, M. (2014)**. Physicochemical, nutritional and functional properties of the epicarp, flesh and pitted sample of doum fruit (*Hyphaene Thebaica*). J Food Nutr Res 2(4):180–186.
9. **Aboshora, W., Lianfu, Z., Dahir, M., Qingran, M., Qingrui, S., Jing, L. and Ammar, A. (2015)**. Effect of extraction method and solvent power on polyphenol and flavonoid levels in *Hyphaene*

Thebaica L Mart (Arecaceae) (doum) fruit, and its antioxidant and antibacterial activities. Trop J Pharm Res 13(12):2057–2063.

10. **Cook, J. A., Vander Jagt, D. J., Pastuszyn, A. G., Glew, R.S., Millison, M. and Glew, H. R. (2000)**. Nutritional and Chemical Composition of 13 Wild Plant Foods of Niger. *Journal of Food Composition and Analysis*, 13, 83-92.
11. **Betty, H., Coupar, M. I. and Ken, N. G. (2006)**. Antioxidant Activity of Hot Water Extract from the Fruit of the Doum Palm "*Hyphaene thebaica*". *Food Chemistry*, 98, 317-328.
12. **Aremu, M. O., Olaofe, O. and Akintayo, T. E. (2006).** Comparative Study on the Chemical and Amino Acid Composition of Some Nigerian Under-Utilized Legume Flours. *Pakistan Journal of Nutrition*, **5**, 34-38.
13. **Brownlee, I. A. (2011)**. The physiological roles of dietary fibre. Food Hydrocolloids 25(2): 238-250.
14. **A.O.A.C. (2005).** Official Methods of Analysis of the Association of Official Analytical Chemists.18th edition, Washington DC
15. **Tadrus, M. D. (1989)**. Chemical and Biological Studies on Some Baby Foods. M.Sc. Thesis. Fac. of Agric. Cairo univ. Cairo, Egypt.
16. **James, C. S. (1995)**. "Analytical Chemistry of Foods". Chap. 6, General Food Studies, Firsted. The Alden press, Oxford, UK.
17. **Boudonas, G., Pattakou, V., Papastefanou, S. and Gioupsanis, T. (1976)**. Qualite des Bles de la Recolte. Cereal institute of Thessaloniki Science Bulletin 58: 9–11
18. **A.A.C.C. (1983)**. American association of cereal chemists. Approved methods of the AACC (8th Ed.). Method 54-21, approved April 1961, revised October 1982. St. Paul, MN: American Association Cereal Chemistry.
19. **Kramer, A. and Twigg, B. A. (1974).** Fundamental of Quality Control for the Food Industry. The Avi publishing Company Inc. Wesstport Connecticut, pp 218-223
20. **Larmond, E. (1997)**. Laboratory method of sensory evaluation of food Publication 1977, Canada, Dept: Agric. Ottawa. 1997
21. **Abd El-Hafez, A. M. M. (2015)**. Chemical nutritional and sensory properties of wheat flour balady fortified by the mixture of wheat germ and doum fruit powders'. International journal of Science and Research, 1565-157.

22. **Hussein, A. M. S., Salah, Z. A. and Hegazy, N. A. (2010)**. Physicochemical, sensory and functional properties of wheat-doum fruit flour composite cakes. Pol. J. Food Nutr. Sci, 60 (3): 237-242
23. **Seleem, H. A. (2015)**. Effect of blending doum (*Hyphaene thebacia*) powder with wheat flour on the nutritional value and quality of cake. J. Food and Nutrition Sciences,6:622-632.
24. **Shouk A. A. and Ramadan M. T. (2007).** Effect of defatted rice bran addition on the quality of pan bread and biscuit. Minufiya J. Agric. Res., 32, 1019–1036.
25. **Durlach, J. (1988)**. Magnesium in clinical practice. Libbey Euro text, London, Paris. p. 360