Physicochemical and Technological Properties of Bread Produced from Wheat Grain Fertilized with Nano Fertilizer

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Abstract: This study was carried out to evaluate the wheat cultivar Sakha 94 produced from normal and nano-fertilization on the physicochemical and rheological properties. Significant differences were found in thousand kernel weight and Hectoliter values between normal and nano fertilizer samples. The extraction rates of 82% and 72% of wheat fertilized by nano fertilization were higher in protein, fat, ash and fiber contents than wheat fertilized with normal fertilizer. As well as, the minerals content (potassium, calcium, magnesium, iron, copper, zinc and phosphors) were higher in wheat nano fertilized than wheat fertilized with normal fertilized one. The same results were found in falling number and gluten percent. The balady and pan bread produced from wheat flour treated with normal fertilized staled faster than nano fertilizer. Sensory properties showed significant differences between normal and nano fertilized in pan bread properties. Significant differences in balady bread were found in appearance, crumb texture, crust color and separation of layers between the two fertilizers treatments. Thus, it is recommended to use nano fertilizer with no effect on environment, no effortless for agricultural soil low-cost and gives a higher yield than normal fertilization.

Keywords: Wheat nano fertilization, balady bread, pan bread, rheological properties, staling, sensory evaluation

INTRODUCTION

Wheat is the major source of food for human nutrition and apart of daily dietary need in one form or more. These is need to increases the wheat productivity horizontally and vertically extension. Wheat cultivation in Egypt is about 1.37 million kg and the average yield of wheat reached about 6.6 t / ha with total production is about 9 million tons which covers only 60 % of the local consumption demand (FAO, 2016).

Therefore, it must be increased wheat cultivated area in long term and increase productivity per area unit in short time by applying the good agricultural practices.

Of all the cereals, only wheat flour has the ability to create dough that can retain the gases generated during fermentation and baking, and to form a spongy porous middle of bread (Shewry *et al*., 2001).

(Hussain *et al.,* 2009) evaluated wheat grains fertilized by conventionally ones gave negative impact on functional properties of wheat flour for bread making and the nutritional composition of wheat flour**.**

The quality of wheat flours can be defined for several parameters including protein, moisture, gluten, sedimentation, enzyme activity and rheological properties (Başlar and Ertugay, 2011).

Nano-technology had proved its place in agriculture and related industries, and has become a pioneer approach in agriculture research nowadays (Heba *et al*., 2016).

Conventional fertilizers are generally applied on the crops. Excess utilizes of fertilizers decrease soil microflora lessens nitrogen – fixation. Moreover it is important to optimize the utilization of chemical fertilization to full all the crop nutrient supplement and to reduce the risk of environmental pollution (Tilman *et al.,* 2002). In this manner, it is necessary to test the other methods to provide the necessary nutrients for growth and yield of the crop, which keeping the soil structure in the great shop and environment clean (Miransari, 2011).

Use nano-fertilizer for control of nutrient release could be considered as an effective way to achieving sub- stainable agriculture and environment. Nano-technology has provided the feasibility of exploring the nano scale or nano strutted materials as a fertilizers as new facilities to enhance the nutrient use efficiency and reduce the cost of environment pollution (Chinnamuth and Boopati, 2009; Singh *et al.,* 2017).

Bakntsari *et al*. (2015) found that application of nano-iron fertilizer: increased protein and Fe concentration in grains and straw of wheat and increased grain yield by 20%. Foliar application of elements gave significant effect on yield traits and protein content of some wheat cultivars (Mekkei and El-Haggan, 2014).

An increase in yield due to foliar application of nano-fertilizers (Tarafdar *et al*., 2014) - Nano-fertilizer increase the growth and yield of selected cereals (Jyothi and Hebsur 2017). Significant increase in plant height, spices number/m^2, spikelets, number / spike, grains number / spike, 1000-kernel weight, grain show and biological yield / fed, as well as harvest index (%) using nano-fertilizer – amino acids during nano fertilizers have unique features like increase in production, ultra-high absorption, increase in photosynthesis, and significant expansion in the leaves surface area (INIC, 2014). Moreover nano fertilizer increase yield, improve soil fertility, reduce pollution and make a favorable

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environment for microorganisms (Ahmed *et al.,* 2012) as well as nano fertilizers providing greater role in crop production and several enhanced growth, yield and quality parameters of the crop which result better yield and quality food product for human and animal consumption (Tarafdar *et al.,* 2012; Singh *et al.,* 2017).

Nano fertilizers provide more surface area and more availability of nutrient to the crop plant which help to increase these quality parameters of the plant (such as protein, oil content, sugar content) by enhancing the rate of reaction (Rajaie and Ziaeyan, 2009).

Nano fertilizers are advantageous over conventional fertilizers as they increase soil fertility yield and quality parameters of the crop, they are nontoxic and less harmful to environment and humans, they minimize cost and maximize profit. Nano particles increase nutrients use efficiency and minimizing the costs of environment protection (Naderi and Abedi, 2012).

Fertilizer nano-technology improved in the nutritional content of crops and the quality of the taste. Optimum use of iron and increase protein content in the grain of the wheat (Farajzadeh *et al.,* 2009).

The physicochemical tests like gluten content, ash content, flour color and falling numbers evaluate important characteristics for the pastry industry (Menegusso *et al.,* 2010).

Balady bread is a unique Egyptian product that represents the main diet component for all consumers (Hefni and Witthoft, 2011).

Besbes *et al.* (2014) defined pan bread or sandwich bread, usually has a thin crust and a crumb with regular porosity, thin- walled cells and a typical structure different from other types of bread. Its texture is soft and elastic thanks to the presence of fat, monoglycerides, milk powder, sugar in the formula of pan bread. Concerning the bread-making process, pan bread is baked in pans with or without a cover leading to a typical process of crust formation. However, this product has a short shelf life and stales rapidly depending on different factors: the bread-making process, storage conditions (room temperature, relative humidity), and baking conditions.

The objective of this study is to evaluate the effect of using nano-fertilized wheat on the physical, rheological, chemical and technological properties of wheat flour (82% and 72% ext.) for production balady and pan bread compared to normal fertilized wheat.

MATERIALS AND METHODS

Materials:

Wheat seeds (*Triticum aestivum* L.) cv (Sakha 94): were obtained from Agriculture Research Center-Agronomy Institute, Giza, Egypt.

Salt (sodium chloride), compressed yeast, sugar (sucrose) and corn oil were obtained from the local market**.** Giza, Egypt**.**

Methods:

Wheat crop was fertilized with zinc (Zn) and iron (Fe) nano particles compared with recommended dose of chemical fertilizers (NPK) as a control at the rate of 75 kg N, 15.5kg P_2O_5/and 24 kg K_2O/fed in the presence of organic matter (chicken manure), then sown on November 2016 at the new reclaimed area of desert located in Wadi El-Notron, Beheira Governorate (Longitude 28°54' E, Latitude 28°20 N and Altitude 130 m) in Egypt. Physical and chemical analyses of the soil under investigation are presented in Table (A) and were determined according to the method described by Jackson (1973).

Land Preparation:

Before planting, the soil was first mechanically ploughed and planked twice till the soil surface has been settled, then plots established.

Chicken manure added:

As Ministry of Agriculture and Land Reclamation recommended 5 tons/fed. Chicken manure was added to the soil one week before planting of wheat control normal fertilizing or wheat nano fertilizing, according to Mahmoud and Sahar (2018). Chemical analyses of manure are presented in Table B.

Table (A): Some physical and chemical properties of the experimental soil

Physical properties		Cations (me. / l)		Anion (me. / l)	
Clay (%)	3.0	Ca++	4.16	$CO_3^=$	0
Silt (%)	6.50	Mg++	1.52	HCO_3^-	0.54
Sand (%)	90.5	Na+	3.24	Cl^-	3.31
Texture grade	Sandy	K+	0.21	$SO_4^=$	2.13
pH (soil paste)	7.8				
EC (dS/m at 25°C)	1.37				
Total-N (%)	0.03				
Organic-C (%)	0.38				

Table (B): Chemical composition of chicken manure

Parameter	Value
Total macronutrients [%]	
N	2.55
P	0.69
K	1.34
Total micronutrients [ppm]	
Fe	28.1
Zn	33.7
Mn	17.1
Cu	21.2
Ph	7.70
C/N ratio	19.5
Organic matter [%]	63.5

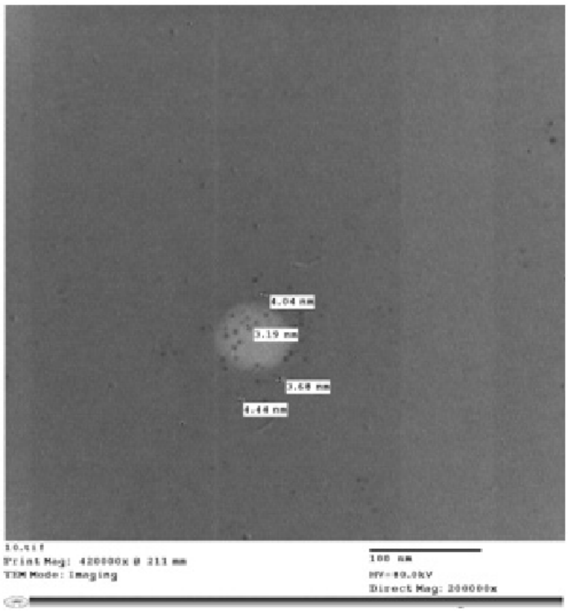
Nano Fe and Zn preparation

Nano iron was prepared with little modify from magnetite (Fe_3O_4) of Fe^{3+} and Fe^{2+} at a molar ratio of 3:2 by reduction–precipitation in aqueous ammonia 0.3

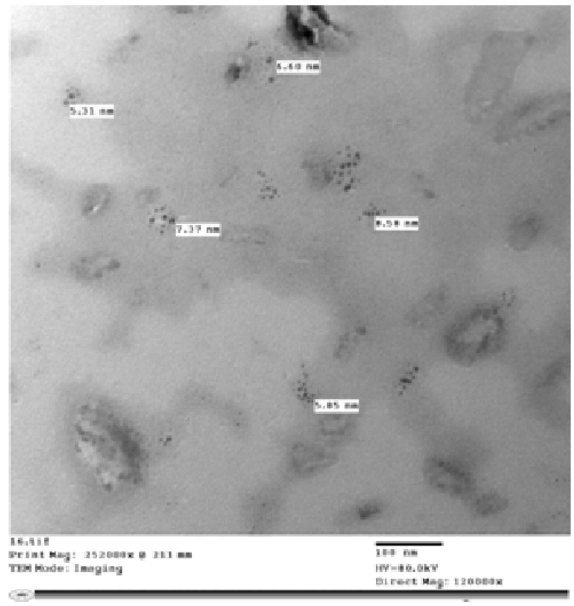
(mol/L) and coated tetramethyl ammonium hydroxide under vigorous stirring for 2 h. using magnetic stirring, precipitate was then separated by magnetic filtration using a permanent magnet, and washed with distilled water until a neutral pH was obtained according to (Qu *et al.,* 1999). While nano zinc was prepared from aqueous solution of zinc sulfate and sodium hydroxide solution was added slowly in a molar ratio of 1: 2 under vigorous stirring for 8 h. The precipitate obtained was filtered and washed thoroughly with ionized water. The precipitate was dried in an oven at 100°C, then expose to 15 psi of pressure for 12 hours (Daneshvar e*t al.,* 2007).

TEM (transmission electronic microscope) image (a & b) was done in TEM lab (FA-CURP) Faculty of Agriculture Cairo University Research Park to determine the nano size (Lal, 2008).

Both Fe and Zn nano particles at concentrations 20 and 40 ppm were applied to (*Triticum aestivum* L.) plants as foliar at 10, 18 and 26 days after planting.



(a) Zinc nano particle



(b) Iron nano particle

Procedure of wheat flour extraction:

The wheat grain was cleanliness and conditioned to moisture contend 14% and kept for 24 hr. as a rest period, then milled as whole using Bühler quadrumat roller mill. Wheat flour passed through sieve No 45 (opening micrometer=355) to obtain 82% ext., and the other part passed through sieve No 60(opening micrometer=250) to obtain 72% ext.

Preparation of balady and pan bread:

Preparation of balady bread:

Balady bread formula is shown in Table (C) which prepared by mixing 1 kg of wheat flour (normal and nano fertilized) with other ingredients including 1.5% compressed yeast, 1.5% sodium chloride and 700-750 ml water. The dough mixed well in mixer (250 rpm) for 20 min. The dough left to ferment at 30°C for 15 minutes. After fermentation, the dough divided into 160g/ pieces. Each piece was moulded on a wooden board previously covered with a fine layer of bran and left to ferment about 15 min. at the same mentioned temperature and 85% relative humidity. The fermented dough pieces were flattened to about 20 cm diameter. The flattened loaves were baked at 400-450°C for 1-2 min. in electric oven. The loaves were allowed to cool at room temperature before organoleptic evaluation (Yaseen, 1985).

Preparation of pan bread:

The straight dough method for pan bread production was carried out according to the method described by (AACC, 2010), the formula is shown in Table (C) which provides: The blends of 1000 g wheat flour (72% ext.), sodium chloride (15 g), compressed yeast (15 g), sugar (15 g), corn oil (15 g). The optimum water amount as determined by farinograph. The ingredients were mixed thoroughly by hand, and then the dough was further mixed in a laboratory mixer for approximately 4 min. The dough was put into a greased fermentation bowl, and then cut, rolled and placed in the metal pans, then put in fermentation cabinet for 50 min. at 37±2^{o}C and 80-85% relative humidity. Then baked in an electric oven at about 220±8^{o}C for 25 min. After baking, loaves were separated from the metal pan and allowed to cool at room temperature for 30 min. before organoleptic evaluation.

Table (C): Formulation of balady and pan bread blends which fertilized by normal and nano fertilizer

Ingredients	Balady bread (gm) (control)	Balady bread (gm) (NF)	Pan bread (gm). (control)	Pan bread(gm) (NF)
Wheat flour 82%ext (control)	1000	-	-	-
Wheat flour 82%ext (NF)	-	1000	-	-
Wheat flour 72%ext (control)	-	-	1000	-
Wheat flour 72%ext (NF)	-	-	-	1000
Corn oil	0	0	15	15
Sugar	0	0	15	15
Sodium chloride	15	15	15	15
Compressed yeast	15	15	15	15
***Water (ml)**	700-750		As required	

NF= nano fertilized

Physical properties of wheat grains:

Cleanliness, shrunken and broken kernels: were determined according to Hamza (2003) as follows: Cleanliness =100 - % dockage.

Hectoliter (kg / hl) and thousand kernel weight were determined according to the method of AACC (2010).

Gluten determination:

Gluten characteristics which include wet gluten%, dry gluten% and gluten index% were estimated according to AACC (2010).

Calculation of wet gluten%, dry gluten%, and gluten index were as follows:

Wet gluten % = [total gluten (g)/ sample weight (g)] × 100.

Dry gluten % = [weight of dry gluten (g)/ sample weight (g)] ×100.

Gluten index% = [wet gluten remaining on the sieve (g) / total wet gluten (g)] × 100.

Falling number test:

Falling number was determined according to AACC (2010).

Chemical analysis:

Moisture, fat, ash, crude fiber, and protein were determined according to AOAC (2005). And then carbohydrate was calculated by the difference.

Mineral determination:

Minerals content were determined according to AOAC (2005) using Atomic Absorption Spectroscopy (Perkin-Elmer, 2380, USA).

Rheological properties of wheat flour:

Rheological properties of wheat flour (72% ext.) were evaluated by using Farinograph and Extensograph apparatens (Brabender- Germany) according to AACC (2010).

Bread evaluation:

Bread specific volume

Specific volume of pan bread was determined by alfalfa seeds displacement method (AACC, 2010) and calculated as the ratio volume/weight (cm^3/g). Specific volume determination triplicate was carried out 1hour, after leaving the oven.

Determination of staling rate:

Alkaline water retention capacity (AWRC) values of balady and pan bread were measured after zero, 24, 48 and 72 h. of bread storage at 20˚C according to method of Yamazaki (1953), as modified by Kitterman and Rubenthaler (1971).

Alkaline water retention capacity was calculated as follows:

$$\text{AWRC \%} = \frac{W2-W1}{W3} X\ 100$$

W1=weight of empty tube (g).

W2= weight of tube with sample after centrifugation (g).

W3 = weight of sample (g).

Sensory evaluation of balady bread:

The loaves of bread were allowed to cool for about 1h before evaluation. Then balady bread by using suggested blends were evaluated for sensory characteristics by ten panelists from the staff of Bread and Pastry Research Department Agric. Res. Center, Giza. The scoring scheme was established as mentioned by Yaseen *et al*. (2007), as follows color (20), appearance (20), taste (20), flavor (20), separation of layers (20) and the total score 100 degrees.

Sensory evaluation of pan bread:

Pan bread by using suggested blends were evaluated for sensory characteristics by ten panelists from the staff of Bread and Pastry Research Department Agric. Res. Center, Giza. The scoring scheme was established as mentioned by Pyler (1988), as follows appearance (15), crust color (15), crumb color (15), texture (15), odor (20) and taste (20) and the total score 100 degrees.

Statistical analysis:

The statistical analysis was carried out using ANOVA with one factor under significance level of 0.05. Data were treated as a complete randomization design according to Steel *et al.* (1997).

RESULTS AND DISCUSSION

The chemical composition of the used raw materials: Physical properties of the wheat grain:

Physical properties of the wheat grains i.e. cleanliness (%), shrunken (%), hectoliter and 1000 – kernel weight (g), are presented in Table (1). No significant difference (P<0.05) was observed in cleanliness among two samples which was ranged from 98.90% to 99.0%. With respect to shrunken, it was noticed that significant difference in normal and nano-fertilized wheat was observed and the shrunken seeds in normal fertilized wheat was higher than the nano-fertilized. On the other hand, significantly higher hectoliter was noticed for nano-fertilized wheat (86.00 Kg/hl.) compared to normal fertilized wheat (81.74 Kg/hl.) Hectoliter one of the most parameters, which are used globally to the distinction between the wheat grain properties, as well it affected by many factors such as genotype, environment and fertilizer (Surma *et al.,* 2012; Mansour, 2015)**.** The weight of 1000- kernel was 47.55 for nano fertilized wheat and 43.20 g for normal fertilized wheat. The results were agreement with Wang *et al.* (2012) who reported that samples with high kernel weight tend to give high hectoliter weight. Also**,** Uddin (2009) reported that 1000-kernel weight values of different wheat varieties were ranged from 39.22 to 43.169. Kernel weight is a measure of average kernel size. Since, the ratio of endosperm to bran is greater in larger kernels; a higher milling yield can be accepted from these kernels (Din *et al.,* 2007). Liu *et al.* (2015) and Kandil and Eman (2017) noticed that, zinc and iron nano fertilization application led to increase wheat grains yield**.**

Table (1): Physical properties of tested wheat grains

Parameters	Wheat cultivar (Sakha 94)		LSD
	Normal fertilization	Nano fertilization	
Cleanliness %	**98.90[a*]**	**99.10[a]**	**0.21**
Shrunken %	**43.99[a]**	**38.02[b]**	**0.01**
Hectoliter (kg/hl)	**81.74[b]**	**86.00[a]**	**0.56**
1000-kernel weight (g)	**43.20[b]**	**47.55[a]**	**0.21**

[*]Means with the same letter in the same row are not significant differences (p<0.05).

Falling number of wheat flour:

The falling number of wheat flour 72 and 82% extraction is considered as an indication for amylase activity (the greater amylolylic activity, the shorter is the time is required). At higher enzyme activity greater, portion of the starch is liquefied (Abd El-Motaleb *et al.,* 2004)**.** Results of falling number of wheat flour 82 and 72% extraction are presented in Table (2). It can be seen that nano fertilization wheat sample showed lower activity of α-amylase (higher falling number value) than normal fertilization in both extraction which falling number in nano fertilization 72, 82% ext were 388 and 450, respectively compared to 358 and 400, respectively for normal fertilized wheat. The higher falling number value for wheat flour 82% may be due to the nature of starch its presence in outer layers.

Table (2): Falling number of wheat flour which fertilized of wheat by normal and nano fertilizer

Wheat flour	Falling number (sec) 72% ext.	Falling number (sec) 82% ext.
Normal fertilization	358[b]*	400[b]
Nano fertilization	388[a]	450[a]
LSD0.05	20.60	39.20

[*]Means with the same letter in the same column are not significant differences (p>0.05).

Determination of wet gluten, dry gluten and gluten index%:

Gluten index is most important to the description of the gluten quality and forecasting the product quality (Czuchajowska and Paszczynska, 1996). The obtained results from the estimated gluten index for wheat flour (82 and 72% ext.) present in Table 3 indicated that, there were significant differences between the wheat normal fertilized both 82 and 72% ext. and nano one. The higher value was found in wheat nano-fertilized 82 and 72% ext.

Results in Table (3) showed that there are a significant differences (P>0.05) between wheat normal fertilized both 82 and 72% ext. and wheat nano-fertilized 82 and 72% ext. for wet and dry gluten%**,** These results are in agreement with Ibrahim *et al.* (2011) and El-Porai *et al.* (2013).

Table (3): Wet gluten, dry gluten and gluten index% of wheat flour which fertilized of wheat by normal and nano fertilizer

Wheat flour	Wet gluten%		Dry gluten%		Gluten index%	
	82%	72%	82%	72%	82%	72%
Normal fertilization	27.84[b]*	25.72 [b]	11.00 [b]	9.65 [b]	81.25 [b]	80.01 [b]
Nano fertilization	28.91 [a]	26.50 [a]	12.09 [a]	10.70 [a]	83.00 [a]	81.09 [a]
LSD 0.05	0.37	0.36	0.66	0.36	0.13	0.02

*Means with the same letter in the same column are not significant differences (p>0.05).

Chemical composition of wheat flour:

The results in Table 4 showed that there were a significant difference (P>0.05) between wheat flour Sakha 94 normal and nano fertilization in both extraction (82 and 72%) in crude protein, ash and carbohydrates. It is clear that, the wheat flour which produced from nano fertilizer of wheat (Sakha 94) is affect on the all tested chemical properties. The highest level of crude protein content was found in nano-fertilization which reached to 15.80% (82% ext.) while was 13.10% (72% ext.). In contrast, the values were 14.63 (82% ext.) and 12.53 (72% ext.) for normal fertilization. There were also an increase in fat, ash and crude fiber as opposed to carbohydrates was decreased. The obtained results of chemical composition of flour under study were found to in agreement with those reported by Kisan *et al.* (2015) who pointed out nano zinc enhanced the absorption of essential nutrients, especially nitrogen which is responsible for higher protein content.

Table (4): Chemical composition% of wheat flour which fertilized of wheat by normal and nano fertilizer

Wheat flour	Moisture	Crude proteins	Fat	Ash	Crude fibers	Total carbohydrates
Normal fertilization 72% ext.	8.92[a*]	12.53[b]	0.89 [a]	1.52 [b]	2.40 [b]	82.66 [a]
Nano fertilization 72% ext.	9.00[a]	13.10[a]	1.00 [a]	1.89 [a]	2.78 [a]	81.23 [b] `
LSD 0.05	0.566	0.547	0.566	0.011	0.227	0.023
Normal fertilization 82% ext.	9.52 [b]	14.63 [b]	1.64 [a]	1.78 [b]	3.30 [a]	78.65 [b]
Nano fertilization 82% ext.	9.95 [a]	15.80 [a]	1.80 [a]	1.99 [a]	3.60 [a]	76.81 [a]
LSD 0.05	0.023	0.253	0.226	0.114	0.443	0.113

*Means with the same letter in the same column are not significant differences (p>0.05).

Minerals content of wheat flour:

Data in Table (5) showed that potassium in normal fertilizer of wheat flour extraction (82%) was 96.60 ppm, while in nano fertilizer was higher (98.70 ppm). The calcium content was 822 ppm, in nano fertilizer significantly higher than normal fertilizer (805 ppm) also the higher content of magnesium was found 23.80 ppm. for nano-fertilized, the lowest content was found 21.96 ppm for normal- fertilized wheat. Iron, copper, zinc, manganese and phosphorus contents also increased in nano-fertilization sample compared with normal fertilizer .Also, this behavior was found in wheat flour (72% ext.) that the flour obtained from the wheat with normal fertilizer was less in minerals, than in nano fertilizer. These results agreed with those reported by Heba *et al.* (2018), Kandil and Eman (2017) who found that application of nano fertilizer led to increase protein, Fe, Zn and Mn contents in grains of wheat and subsequently increased grain yield.

Table (5): Minerals content of wheat flour which fertilized wheat flour by normal and nano fertilizer (ppm on dry weight basis)

Wheat flour	Macro elements				Micro elements				
	K	Ca	Mg	Na	Fe	Cu	Zn	Mn	P
Normal fertilization 82%ext.	96.60	805	21.96	46.09	12.00	0.35	0.95	0.87	4799
Nano fertilization 82%ext.	98.70	822	23.80	64.90	14.30	0.37	1.95	0.95	4906
Normal fertilization 72%ext.	80.00	799.0	21.00	41.90	11.17	0.30	0.80	0.70	3720
Nano fertilization 72%ext.	85.10	810	22.00	42.19	12.90	0.34	1.11	0.82	4000

Rheological characteristics of wheat flour:

Data presented in Table (6) showed that wheat flour 72% ext. produced from sakha 94 fertilized with nano fertilization resulting higher water absorption compared to normal fertilization, may be due to that contained higher protein, fiber and minerals. Similar finding was observed by Indrani *et al*. (2003) who stated that protein and pentosants increased the water absorption of flour.

Regarding to arrival time (min), dough development time (min) and dough stability time (min) for wheat flour produced from sakha 94 fertilized with nano fertilization increased compared to wheat fertilized with normal fertilization.

Data in Table (6) showed higher extensibility in normal fertilizer wheat flour (72% ext.) and lower resistance to extension with compared to nano fertilizer. Nano fertilizer recorded the higher values of resistance to extension (620 B.U.), while, normal fertilizer had the lower values (560 B.U). From the obtained data, nano fertilizer which had low extensibility, thus the proportional number was higher in nano fertilizer (5.6) than in normal fertilizer (4.8).Generally the fertilization by nano fertilizer had positive effect on the rheological characteristics of the dough than the normal fertilizer.

Table (6): Farinograph and extensograph parameters of wheat flour which fertilized of wheat by normal and nano fertilizer

Wheat flour	Farinograph properties				
	W.A	M. T. (min)	Dev. T. (min)	Sta. T. (min)	D.W (B.U)
wheat flour 72%ext. normal Fertilization	62.40	1.00	2.00	5.00	150
wheat flour72% nano Fertilization	63.88	1.5	2.5	5.50	145

Extensograph properties

Wheat flour	Res. to Ext. (B.U)	Extensibility	P.N.	Energy (cm^2)
wheat flour72%ext. normal Fertilization	560	116	4.8	100
wheat flour72%ext. nano Fertilization	620	110	5.6	110

W. A.: Water absorption **M. T.:** Mixing time **Dev. T.:** Development time **Sta. T.:** Stability time
D. W.: Degree of weakening **(B. U.):** Brabender unit
Res. to Ext.: Resistance to extension **P. N. :** Proportional number

Staling of pan and balady bread produced from wheat flour:

Alkaline water retention capacity (AWRC) is a simple and quick test to follow staling of bread. Higher values of AWRC mean higher freshness of bread (Yaseen *et al.*, 2010; Giannone *et al.*, 2016).

The changes occurring in freshness characteristic of different pan and balady bread samples stored at zero, 24, 48 and 72 h. at room temp 30±2ºC are shown in Table (7). It could be observed that freshness of pan and balady breads gradually decreased by increasing the period of storage. After 72 h. of storage, the lower reduction in stalling value (high freshness) was observed in pan and balady bread prepared from wheat flour which fertilized of wheat by nano fertilizer which reaches to170 and 190% respectively. Compared to the higher reduction in staling value (low freshness) in pan bread and balady bread prepared from sakha94 (control) flour (127 and 140%, respectively). Such increase of freshness in balady bread (190%) compared to pan bread (170%) may be due to its higher protein content which binding more moisture, these results are in agreement with those reported by Yaseen *et al.* (2010) and Salehifar *et al.* (2010) who's mentioned that the reason for higher moisture in bread after storage is due to the content of protein. Therefore, the high level of protein regardless of its quality which provides the cysteine amino acid sufficiently to show a better improvement. The above mentioned changes are possible to predict before the bread manufacturing through the farinograph and exstensograph profiles.

Specific volume of pan bread produced from wheat flour:

Specific volume is one of the most important parameters which depends on flour properties mostly the protein network strength, under the targeted improvement of Egyptian wheat flour, to measure the modification that could occur when nano fertilizer used**.** The results obtained, in Table (8) indicated that there are a significant differences between normal and nano fertilized for volume, weight and specific volume of pan bread. There is reason explained to this improvement, increasing of the gluten strength by nano fertilizer which lead to increase the retention rate of fermentation gas, the increase rate of specific volume as reported by Patricia and Caroline (2014), El-Porai *et al.* (2013).

Table (7): Alkaline water retention capacity (AWRC%) of pan and balady bread produced from wheat flour which fertilized of wheat grain by normal and nano fertilizer

pan bread samples	Storage periods (h)			
	Zero	24	48	72
Normal Fertilization	230[b*]	210[b]	170[b]	127[b]
Nano Fertilization	250[a]	230 [a]	200[a]	170[a]
LSD 0.05	16.0	16.0	16.0	16.0
Balady bread samples				
Normal Fertilization	263[b]	235[b]	200[b]	140[b]
Nano Fertilization	281[a]	265[a]	240[a]	190[a]
LSD 0.05	16.0	32.0	32.0	16.0

*Means with the same letter in the same column are not significant differences ($p>0.05$)

Table (8): Specific volume of pan bread produced from wheat flour which fertilized of wheat grain by normal and nano fertilizer

Treatment	Volume (cm^3)	Weight (g)	Specific volume (cm^3/g)
Normal Fertilization	447.20 [b*]	128.50 [a]	3.48 [b]
Nano Fertilization	454.00[a]	120.40 [b]	3.77 [a]
LSD 0.05	5.06	6.60	0.16

*Means with the same letter in the same column are not significant differences ($p<0.05$)

Sensory evaluation of balady bread:

The sensory quality attributes of- balady bread samples are presented in Table (9). The results indicated that all sensory attributes of balady bread made from wheat fertilized by nano fertilizer are significantly higher values than normal ones, and balady bread quality of nano fertilizer was superior to that of normal fertilizer. From the same results, balady bread produced from wheat flour of nano fertilizer had significantly higher total scores (95.70) than bread produced from normal fertilizer (82.50).

Sensory evaluation of pan bread:

The sensory quality attributes of pan bread samples are presented in Table 10. The results indicated that all sensory attributes of pan bread made from wheat fertilized by nano fertilizer is significantly higher values than normal fertilizer, and pan bread quality of nano fertilizer was superior to that of normal fertilizer. From the same results, pan bread produced from wheat flour of nano fertilizer had significantly higher total scores (97.27) than bread produced from normal fertilizer (81.86).

Table (9): Sensory evaluation of balady bread produced from wheat flour which fertilized of wheat grain by normal and nano fertilizer

Balady bread	Appearance (15)	Crumb texture (15)	Crust color (15)	Separation of layers (15)	Roundness (10)	Oder (15)	Taste (15)	Overall acceptability
Normal Fertilization	11.00[b*]	13.00[b]	12.50[b]	12.00[b]	8.00[b]	13.50[b]	12.50[b]	82.50[b]
Nano Fertilization	13.50[a]	14.00[a]	14.60. [a]	15.00[a]	9.80[a]	14.50[a]	14.30[a]	95.70[a]
LSD 0.05	0.800	0.800	0.577	1.27	0.599	0.801	0.660	0.704

*Means with the same letter in the same column are not significant differences ($p>0.05$)

Table (10): Sensory evaluation of pan bread produced from wheat flour which fertilized of wheat grain by normal and nano fertilizer

Pan bread	Appearance (15)	Crust color (15)	Crumb Color (15)	Texture (15)	Odor (20)	Taste (20)	Total score (100)
Normal Fertilization	12.00[b]*	12.00 [b]	11.10[b]	12.73[b]	17.83[b]	16.20[b]	81.86[b]
Nano Fertilization	14.80[a]	14.20[a]	14.50[a]	14.16[a]	19.76[a]	19.85[a]	97.27[a]
LSD0.05	0.609	0.609	0.577	0.041	0.239	0.233	0.032

*Means with the same letter in the same column are not significant differences ($p>0.05$)

CONCLUSION

It could be concluded that using of wheat flour which produced form nano fertilized wheat increased the size of the crop by increasing the weight of the hectoliter and the thousand kernels, and the decreasing of the incomplete and broken grains. Moreover, a significant increase in the content of protein and minerals were occurred which improved the sensory properties of the produced bread. For such advantages above mentioned, it is recommended to use of nano fertilizer instead of normal fertilizer**.** Also finds that the nano fertilizer does not have any effect on the health or the environment and is not effortless agricultural soil and is not expensive, it is recommended to use of nano fertilizer instead of normal fertilizer.

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تقييم الخواص الفيزيوكيميائية والتكنولوجية للخبز المنتج من القمح المسمد بالسماد النانو

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أجريت هذه الدراسة لتقييم الخصائص الطبيعية والكيميائية والريولوجية للخبز الناتج من القمح صنف سخا ٩٤ الناتج من التسميد الطبيعي والتسميد النانو وقد وجدت فروق معنوية في وزن الألف حبة والهكتوليتر بين عينات السماد العادى والنانو وكانت معدلات استخراج ٨٢٪ و ٧٢٪ من القمح المسمد بالنانو أعلى في محتوى البروتين والدهون والرماد والألياف بالمقارنة بالسماد العادى. وكذلك وجدت نفس النتائج في محتوى المعادن (البوتاسيوم - الكالسيوم - المغنيسيوم - الحديد - النحاس - الزنك والفسفور) ورقم السقوط ونسبة الجلوتين. وبإنتاج الخبز البلدي وخبز القوالب من دقيق القمح المسمد بالسماد العادي حدث لهما بيات أسرع من دقيق القمح المسمد بالأسمدة النانوية وأيضا أظهرت الخصائص الحسية فروق معنوية في خصائص خبز القوالب ووجدت فروق معنوية في المظهر، الملمس، لون القصرة وفصل الطبقات في الخبز البلدي بين نوعي الأسمدة. لذلك يجب الاهتمام باستخدام الأسمدة النانوية وتطبيقها على المحاصيل الحقلية لإنتاج محصول أعلى دون أي تأثير على البيئة أو أي جهد للتربة الزراعية عكس التسميد العادي.

الكلمات الدالة:

التسميد النانو، الخصائص الفيزيائية للقمح، الخبز البلدى، خبز القوالب، التركيب الكيماوى، الخصائص الريولوجية، التجلد