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THE ROLE OF PHYTASE ON THE QUALITY OF THREE TYPES OF EGYPTIAN BREADS

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ABSTRACT

The extent of phytate degradation along with the quality of the three commercial types of breads that are widely consumed in Egypt (i.e. *Balady*, *Shamy* and *Sinn*) as affected by adding *A. niger* phytase during bradmaking were the aim of this study . Proximate chemical composition of wheat flours 72% and 82% extraction and *sinn* flour ; physical properties ; organoleptic properties ; moisture content ; pH value ; phytic acid content ; crude protein content and *in vitro* protein digestibility of phytase treated and untreated breads were carried out . Data revealed that proximate chemical composition of flours varied significantly and *sinn* flour had the highest contents of protein , crude ether extract , ash and crude fiber in contrary to wheat flour 72% extraction . Physical properties along with organoleptic properties of breads didn't affect by phytase addition . The pH value and phytic acid content decreased significantly with fermentation time elongation . The % reduction of phytic acid during breadmaking were up to 38.2% and 70.8% (*Balady* breads) ; 49.1% and 76.3% (*Shamy* breads) ; and 32.1% and 63.3% (*Sinn* breads) for phytase untreated and treated samples , respectively . The *in vitro* protein digestibility increased markedly on adding phytase . The % increases were up to 37.8% , 34.5% and 35.2% for *Balady , Shamy* and *Sinn* breads, respectively .

Keywords : Wheat flours , wheat breads , phytates , *A. niger* phytase , chemical composition , physical properties , organoleptic properties , *in vitro* protein digestibility .

INTRODUCTION

Bread is an essential food in human nutrition . It is a good source of energy , and contains groups of vitamin B , protein , and minerals which are essential in our diet (Demirözüt, *et al.* , 2003) . In Egypt , bread constitutes an important food for all people since it comprises 60 to 70 % of the food consumption and provides 60 % of daily protein intake .

Among the poor classes , about 90 % of their calories are derived from bread and cereal (CAPMS , 1998 and Saleh , 2003) . Unfortunately , bread may contain considerable amounts of phytate as an antinutritional factor . This is an undesirable compound because it can bind multivalent cations to form insoluble complexes , thus it may cause mineral deficiencies in humans , especially the high risk groups , i.e. children , pregnant and lactating women and the elderly (Ullah and Kandan , 1998). It also forms complexes with proteins making them less susceptible to proteolytic digestion (de Rahm and Jost , 1979) .

Bayomy (2006) mentioned that the commercial types of breads that widely consumed in Egypt are *Balady* bread (wheat flour , 82 % extraction) , *Shamy* bread (wheat flour , 72 % extraction) and *Sinn* bread (called *Sinn* flour in Egypt , wheatfeed as Shorts in the USA , or Pollard in Australia as reported by Kent and Evers , 1994).

In wheat , the endosperm is almost devoid of phytate , but the aleurone layers of the kernel and the bran contain substantial amounts (Lasztity, 1990) which suggests the relatively high phytic acid concentration in high extraction and bran products rather than products made from white flour (Tabekhia and Toma , 1979 ; Fretzdorff , 1993) .

The following factors have been reported to increase phytic acid destruction during breadmaking : adding acetic acid to decrease the pH of dough to 5.2 (De Lange *et al.* , 1961) and sour dough and yeast fermentation , the more vigorous the fermentation the greater the destruction (Lasztity and Lasztity , 1990 ; Wolters *et al*. , 1993 ; Almana , 2000) ; and additions of sodium bicarbonate and / or mono calcium phosphate (Faridi *et al.*, 1981). Phytate degrading enzymes are of potential interest in the improvement of phosphorous bioavailability besides other minerals e.g. Fe , Zn , Ca , Mg (Piddington *et al*. , 1993) . However , addition of phytase particularly fungal phytase (E.C. 3.1.3.8) during processing of foods to eliminate the negative effect of phytic acid was suggested by many researchers (Zyta , 1992 ; Sandberg , 1994 ; Kyriakidis *et al.* , 1998) . Effects of adding phytase from *Aspergillus niger* to dough on hydrolysis of phytic acid during breadmaking was carried out. Data showed an increased degradation of phytate (Tuerk and Sandberg, 1992) .

The objective of the current work was to investigate the extent of phytate degradation along with the quality of the three commercial types of breads that are widely consumed in Egypt as affected by using a commercial preparation of *Aspergillus niger* phytase during breadmaking .

MATERIALS AND METHODS

Materials :

Wheat flours (72% & 82% extraction) and *Sinn* flour were kindly obtained from Middle and West Delta Mills, Damanhour, Behera Governorate, Egypt . *Aspergillus niger* phytase , 5,000 $FTUg^{-1}$, natuphos® , was kindly provided from BASF, Ludwigshafen , Germany . Compressed fresh yeast, table salt and sugar were purchased from the local market at Alexandria, Egypt .

Methods :

Breadmaking :

Wheat flour (82% extraction) , wheat flour (72% extraction) and *Sinn* flour were used to prepare *Balady (Mager*) bread , *Shamy* bread and *Sinn* bread , respectively . Two experiments were carried out for each type of bread , i.e. without and with the addition of phytase during mixing process. The recommended dose is 500 FTU/ kg flour at optimum pH5.5 .

The basic formula included 2 Kg flour, 20 g compressed fresh yeast, 20 g table salt, in addition to 50 g sugar in case of *Shamy* bread only . The required amount of tap water was added to obtain optimum dough consistency and the mixture was mechanically mixed for 5 min. ,then the resulting developed dough was covered and allowed to ferment at ambient temperature (20 ± 2 ^{o}C) for 30 min. intervals up to 180 min. After the given time of fermentation , the dough was divided by hand into balls at

predetermined weight 140 g. The balls were flattened by hand with sprinkling the same type of flour to obtain familiar round loaf with ~ 3 mm thickness and ~ 16 cm in diameter , then were proofed in a warm place for 15 min. and were baked in an oven for 2 min at approximately 400 ^{o}C .

Physical properties

Loaf weight (g), loaf diameter and height (cm), loaf volume (cm^3) and specific loaf volume (cm^3 /g) were determined according to Bayomy (2006) .

Organoleptic properties :

Different bread samples understudy were presented simultaneously to a panel of 10 panelists. The panelists were asked to rank each sample on the hedonic scale of 1 (very poor); 2-4(poor); 5-6 (fair); 7-8 (good); and 9-10(excellent) for each of color, flavor, texture of the crumb and overall acceptability (Moskowitz, 1974).

Chemical analysis :

Moisture, crude protein using the factor 5.7, crude ether extract , ash, crude fiber contents and the value of pH using HANNA Instruments, Hi 9321W, Portugal , were determined according to AACC (1989) methods (No. 44-15A) , (No. 46-10) , (No. 30-10) , (No. 08-01), (No. 32-10) and (No. 02-52) , respectively . N-free extract was calculated by difference . Phytic acid was determined according to the procedure of Thompson and Erdman (1982) . The conversion factor 3.546 was used to convert phosphorus into phytic acid . Pepsin followed by pancreatin digestion was carried out to determine *in-vitro* protein digestibility as described by Saunders *et al.* (1973) . Pure casein (BDH Chemicals Ltd. , England) was used as a reference protein .

Statistical analysis:

The data were statistically analyzed by standard method of analysis of variance , mean separation was determined using Duncan's multiple range test and correlation coefficient was calculated as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

The proximate chemical composition of different wheat flours (i.e. 72% extraction , 82% extraction and *Sinn* flours) are presented in Table 1. It was clear that their contents varied significantly and generally, *Sinn* flour had markedly the highest contents of all constituents except N –free extract in contrary to wheat flour (72% and 82% extractions) .

Table 1 : Proximate chemical composition of different wheat flours (on dry weight basis)* .

Flour	Moisture (%)	Protein (Nx5.7,%)	Fat (%)	Ash (%)	Crude fiber(%)	N-free extract(%)
Wheat flour 72%	11.81^{b}	10.75^{c}	1.08^{c}	0.52^{c}	0.17^{c}	87.48
Wheat flour 82%	11.33^{c}	11.27^{b}	1.30^{b}	0.89^{b}	0.28^{b}	86.27
Sinn flour	12.56^{a}	15.80^{a}	4.68^{a}	3.56^{a}	5.17^{a}	70.79

*** Means in a column not sharing the same superscript are significantly different at p≤.05.**

Data for the physical properties of different breads understudy are presented in Table 2 .

Table 2 : Physical properties of different bread samples* .

Fermentation time (min)	Loaf weight (g)	Loaf diameter (cm)	Loaf max. height (cm)	Loaf volume (cm^3)	Specific volume (cm^3/ g)
Balady Bread					
Without phytase					
0	121.7^{a}	16.5^{a}	4.5^{g}	310^{f}	2.54
30	120.8^{a}	16.0^{a}	6.5^{f}	445^{e}	3.68
60	122.2^{a}	16.0^{a}	7.0^{de}	505^{d}	4.13
90	120.5^{a}	16.5^{a}	7.2^{cd}	530^{c}	4.39
120	118.9^{a}	17.0^{a}	7.5^{bc}	545^{c}	4.58
150	121.0^{a}	16.7^{a}	8.0^{a}	580^{ab}	4.79
180	120.7^{a}	17.0^{a}	6.8^{ef}	495^{d}	4.10
With phytase					
0	121.0^{a}	15.9^{a}	4.2^{g}	305^{f}	2.52
30	122.7^{a}	16.0^{a}	6.5^{f}	430^{e}	3.50
60	120.3^{a}	16.2^{a}	7.2^{cd}	525^{c}	4.36
90	119.1^{a}	16.0^{a}	7.8^{ab}	570^{b}	4.78
120	120.4^{a}	16.5^{a}	8.0^{a}	595^{a}	4.94
150	118.8^{a}	16.8^{a}	7.9^{a}	570^{b}	4.79
180	120.0^{a}	16.2^{a}	7.3^{c}	530^{c}	4.41
Shamy Bread					
Without phytase					
0	118.2^{a}	16.1^{a}	3.7^{h}	290^{h}	2.45
30	120.7^{a}	16.6^{a}	6.1^{g}	520^{cd}	4.30
60	116.5^{a}	16.0^{a}	7.2^{d}	565^{a}	4.84
90	117.3^{a}	15.9^{a}	7.6^{bc}	530^{bc}	4.51
120	120.0^{a}	16.1^{a}	7.4^{cd}	530^{bc}	4.41
150	118.5^{a}	15.6^{a}	7.6^{bc}	510^{de}	4.30
180	119.1^{a}	16.8^{a}	8.0^{a}	570^{a}	4.78
With phytase					
0	121.3^{a}	16.2^{a}	4.2^{fg}	320^{g}	2.63
30	118.7^{a}	16.2^{a}	6.4^{f}	460^{f}	3.87
60	118.2^{a}	15.8^{a}	6.8^{e}	490^{e}	4.14
90	120.5^{a}	17.0^{a}	7.5^{cd}	540^{b}	4.48
120	120.9^{a}	15.9^{a}	7.2^{d}	520^{cd}	4.30
150	116.2^{a}	16.8^{a}	8.0^{a}	570^{a}	4.90
180	118.6^{a}	16.2^{a}	7.8^{ab}	555^{a}	4.67
Sinn Bread					
Without phytase					
0	124.8^{a}	15.2^{a}	3.5^{g}	280^{f}	2.24
30	127.3^{a}	16.2^{a}	5.0^{e}	370^{d}	2.90
60	126.6^{a}	15.7^{a}	5.9^{c}	450^{b}	3.55
90	127.1^{a}	16.0^{a}	6.8^{a}	480^{a}	3.77
120	124.4^{a}	16.1^{a}	6.4^{b}	470^{a}	3.77
150	125.5^{a}	15.0^{a}	5.7^{cd}	420^{c}	3.34
180	126.0^{a}	16.0^{a}	5.5^{d}	420^{c}	3.33
With phytase					
0	126.4^{a}	16.4^{a}	3.6^{g}	280^{f}	2.21
30	125.7^{a}	16.3^{a}	3.9^{f}	300^{e}	2.38
60	127.3^{a}	16.0^{a}	5.5^{d}	380^{d}	2.98
90	126.5^{a}	16.4^{a}	5.7^{cd}	440^{b}	3.47
120	127.9^{a}	15.8^{a}	5.9^{c}	420^{c}	3.28
150	128.4^{a}	16.0^{a}	6.3^{b}	450^{b}	3.50
180	126.9^{a}	15.7^{a}	5.7^{c}	420^{c}	3.30

*** Means in a column (within the same type of bread) not sharing the same superscript are significantly different at p≤ .05 .**

It was clear that the loaf weight and diameter didn't show any significant difference within the same type of bread and between phytase treated and untreated samples as well . Notwithstanding, the loaf maximum height and volume showed highly significant differences and this finding directly related to the fermentation period rather than the factor of phytase addition which confirms that such phytase addition didn't cause any deteriorative effect on the physical properties of resulted bread . As a result , specific volume of the loaf significantly increased with fermentation time

elongation no matter of phytase addition . Generally , the rate of increments concerning maximum height , volume and specific volume of different breads were markedly high during the first stages of fermentation (up to 90 min.) followed by a steady state with a moderate fluctuation (up to 180 min.).

The organoleptic properties of breads (Table 3) further confirmed along with the physical properties (Table 2) that addition of phytase didn't affect such properties .

Table 3 : Organoleptic properties of different bread samples * .

Fermentation time (min)	Crumb color	Flavor	Crumb texture	overall accept.
Balady Bread				
Without Phytase				
0	7.3^{b}	7.3^{c}	6.0^{e}	6.1^{f}
30	7.4^{b}	7.3^{c}	6.8^{d}	7.0^{e}
60	7.3^{b}	7.5^{c}	7.3^{c}	7.4^{d}
90	7.5^{b}	7.5^{c}	8.0^{b}	7.9^{bc}
120	8.0^{ab}	8.2^{ab}	8.1^{b}	8.3^{ab}
150	8.1^{a}	8.6^{a}	8.6^{a}	8.6^{a}
180	7.4^{b}	8.2^{ab}	8.2^{b}	8.0^{b}
With Phytase				
0	7.7^{b}	7.3^{c}	6.2^{e}	6.4^{f}
30	7.4^{b}	7.3^{c}	7.0^{cd}	7.1^{e}
60	7.4^{b}	7.3^{c}	7.1^{c}	7.6^{cd}
90	7.6^{b}	8.2^{ab}	8.3^{ab}	8.1^{ab}
120	7.7^{b}	8.2^{ab}	8.3^{ab}	8.4^{a}
150	8.2^{a}	8.4^{a}	8.3^{ab}	8.2^{ab}
180	7.7^{b}	8.0^{b}	8.0^{b}	8.1^{ab}
Shamy Bread				
Without Phytase				
0	7.3^{d}	7.1^{e}	6.0^{e}	6.6^{f}
30	8.0^{c}	7.8^{c}	7.0^{d}	7.3^{e}
60	8.3^{bc}	7.9^{c}	7.6^{c}	7.8^{d}
90	8.8^{a}	8.0^{bc}	8.1^{b}	8.4^{bc}
120	8.9^{a}	8.6^{a}	8.7^{a}	8.9^{a}
150	8.6^{ab}	8.7^{a}	8.7^{a}	8.7^{ab}
180	8.6^{ab}	8.6^{a}	8.3^{b}	8.7^{ab}
With Phytase				
0	8.5^{ab}	7.6^{d}	6.8^{d}	7.0^{e}
30	8.2^{bc}	7.6^{d}	7.1^{d}	7.3^{e}
60	8.2^{bc}	7.8^{cd}	7.5^{c}	7.7^{d}
90	8.8^{a}	8.6^{a}	7.9^{c}	8.1^{cd}
120	8.8^{a}	8.3^{ab}	8.4^{ab}	8.6^{ab}
150	8.7^{a}	8.3^{ab}	8.7^{a}	8.9^{a}
180	8.7^{a}	8.1^{bc}	8.4^{ab}	8.6^{ab}
Sinn Bread				
Without Phytase				
0	7.1^{c}	6.7^{d}	6.4^{f}	6.6^{d}
30	7.2^{c}	7.0^{cd}	6.7^{f}	7.1^{c}
60	7.1^{c}	7.3^{bc}	7.3^{d}	7.1^{c}
90	7.3^{bc}	7.9^{a}	7.4^{cd}	7.1^{c}
120	7.2^{c}	8.0^{a}	7.6^{c}	7.7^{b}
150	7.1^{c}	8.2^{a}	7.9^{b}	7.9^{ab}
180	7.3^{bc}	8.0^{a}	7.4^{d}	7.5^{bc}
With Phytase				
0	7.4^{bc}	6.7^{d}	6.7^{f}	6.6^{d}
30	7.6^{b}	7.1^{c}	7.1^{e}	7.0^{c}
60	7.7^{ab}	7.6^{b}	8.0^{b}	7.6^{b}
90	7.8^{a}	7.6^{b}	7.9^{b}	7.6^{b}
120	8.1^{a}	8.3^{a}	8.6^{a}	8.3^{a}
150	8.0^{a}	8.1^{a}	8.5^{a}	8.0^{a}
180	8.0^{a}	8.0^{a}	8.1^{b}	7.9^{ab}

*** As in Table 2 .**

However , the values of organoleptic properties increased significantly with fermentation time elongation (up to 150 min.) . The point of interest was that the overall acceptability strongly correlated with the crumb texture (r = 0.956**) and flavor (r = 0.880**) more than color (r = 0.671*) of the

bread no matter of adding phytase or not . However , all samples understudy are accepted from the organoleptic point of view .

The moisture content of bread samples understudy are presented in Table 4 . It was clear that moisture content in *Sinn* bread was significantly higher than that for the other two types of breads i.e. *Balady* and *Shamy* breads . This may be due to the high fiber and protein contents in *Sinn* flour which improve the water holding capacity (Hong, *et al*. , 2000) . However , addition of phytase and / or fermentation time didn't affect the moisture content of resultant breads .

Table 4 : Moisture content of different bread samples* .

Fermentation time (min)	*Balady* bread	*Shamy* bread	*Sinn* bread
Without phytase			
0	28.50^{ab}	23.88^{b}	38.00^{a}
30	30.17^{a}	23.35^{b}	37.04^{ab}
60	28.86^{ab}	26.28^{a}	36.08^{b}
90	25.56^{b}	26.83^{a}	37.46^{ab}
120	27.17^{b}	26.15^{a}	37.67^{ab}
150	28.73^{ab}	26.13^{a}	36.99^{ab}
180	30.13^{a}	23.51^{b}	35.76^{bc}
With phytase			
0	26.00^{b}	23.30^{b}	35.69^{bc}
30	29.29^{a}	27.06^{a}	34.74^{c}
60	30.15^{a}	26.50^{a}	36.67^{ab}
90	30.99^{a}	24.90^{ab}	34.04^{c}
120	29.47^{a}	26.69^{a}	36.12^{ab}
150	30.53^{a}	23.63^{b}	35.46^{bc}
180	29.48^{a}	26.13^{a}	35.10^{bc}

*** As in Table 2 .**

Data presented in Table 5 show the pH values of bread samples . It was clear that fermentation time elongation resulted in a gradual decline in the pH value and this was true for the three types of bread . Meanwhile, addition of phytase generally didn't affect the pH value . Abd El- Fattah (2002) found that pH values of *Balady* and *Shamy* breads were 5.75 and 5.85 , respectively . He concluded that such variation could be attributed to diversity in wheat extraction ratio and fermentation time . However , Fretzdroff and Brummer (1992) postulated that pH was the most important factor in reducing phytic acid content in dough during breadmaking .

Phytic acid contents of different types of bread as a function of phytase addition and fermentation time are presented in Table 6 . Generally, phytic acid contents reduced significantly with fermentation time elongation . The reduction of phytic acid content in breads free of phytase addition (up to 49.1% for *Shamy* bread) may be due to phytase activity naturally occurring in flour and / or yeast (Turk *et al*., 1996) . The same trends were reported by Almana (2000) who found that breads demonstrated 11 – 46% phytate degradation after baking depending on the type of flour and bread . The point of interest was that addition of phytase doubled the reduction (%) of phytic acid . In other words , adding phytase during breadmaking resulted in an additional reduction of phytic acid through hydrolysis process markedly more than that naturally occurring and / or yeast phytase did .

Table 5 : Values of pH for different bread samples* .

Fermentation time (min)	*Balady* bread	*Shamy* bread	*Sinn* bread
without phytase			
0	5.77[a]	5.85[a]	5.70[a]
30	5.70[a]	5.72[b]	5.63[a]
60	5.58[b]	5.63[c]	5.52[b]
90	5.42[c]	5.48[d]	5.40[c]
120	5.30[d]	5.40[de]	5.31[cd]
150	5.18[e]	5.35[ef]	5.15[e]
180	5.11[e]	5.37[ef]	5.12[e]
with phytase			
0	5.80[a]	5.89[a]	5.68[a]
30	5.71[a]	5.80[a]	5.63[a]
60	5.56[b]	5.68[b]	5.50[b]
90	5.41[c]	5.55[c]	5.37[c]
120	5.30[d]	5.43[de]	5.30[d]
150	5.15[e]	5.37[ef]	5.18[e]
180	5.09[e]	5.34[f]	5.12[e]

*** As in Table 2 .**

However , the phytic acid content in breads reduced by 70.8% , 76.3% and 63.3% from their initial contents in *Balady , Shamy* and *Sinn* breads , respectively as a result of adding phytase . It seemed to be the high content of phytic acid along with certain constituents e.g. protein and ash contents are likely responsible factor for low phytate degradation in *Sinn* bread . Tabekhia and Toma , 1979 mentioned that phytic acid content was significantly correlated with protein and ash contents , and the milling extraction rate . Garcia *et al*., (1999) reported that phytic acid loss during breadmaking was higher in white bread than bread made from bran flour . However , development of bread types with high fiber concentration but low phytic acid concentration is required (Bos *et al*., 1997). It was reported that complete removal of phytate was difficult when exogenous phytase was added to phytase – deactivated wheat bran and this probably depended on the particle size of the bran which , despite milling , was larger than that of flour (Sandberg and Svanberg , 1991) .

Table 6 represents data concerning crude protein contents and *in vitro* protein digestibility of different bread samples understudy . It was noticed that although protein content didn't change significantly during breadmaking and through fermentation period , the *in vitro* protein digestibility increased markedly . Moreover , addition of phytase resulted in further increment in the *in vitro* protein digestibility of breads . The improvement (%) that reached 37.8% , 34.5% and 35.2% in *Balady , Shamy* and *Sinn* breads , respectively may be related directly with the reduction in phytic acid content rather than other factors .

Table 6 : Phytic acid , crude protein contents and *in vitro* protein digestibility of different types of flours and breads* .

fermentation time (min)	Phytic acid		Crude protein %	Protein digestibility	
	mg/100g	reduction %	(N X 5.7)	%	improve %
Balady bread flour	359[a]	0.0	11.27[c]	60.1[g]	0.0
Without Phytase 0	348[ab]	3.1	11.35[c]	65.7[f]	9.3
30	331[bc]	7.8	1.41[bc]	66.4[f]	10.5
60	318[c]	11.4	11.48[bc]	67.9[ef]	13.0
90	292[d]	18.7	11.59[ab]	69.3[e]	15.3
120	268[e]	25.3	11.70[a]	71.5[e]	19.0
150	245[f]	31.7	11.83[a]	73.0[d]	21.5
180	222[g]	38.2	11.88[a]	74.8[d]	24.5
With Phytase 0	340[b]	5.3	11.26[c]	66.8[f]	11.1
30	303[cd]	15.6	11.41[bc]	70.4[e]	17.1
60	255[ef]	28.9	11.50[bc]	74.9[d]	24.6
90	213[g]	40.7	11.58[ab]	78.8[c]	31.1
120	168[h]	53.2	11.75[ab]	80.2[bc]	33.4
150	130[i]	63.7	11.88[a]	81.5[ab]	35.6
180	105[j]	70.8	11.85[a]	82.8[a]	37.8
Shamy bread flour	295[a]	0.0	10.75[b]	63.3[g]	0.0
Without Phytase 0	280[a]	5.1	10.86[ab]	70.5[f]	11.4
30	262[b]	11.2	10.73[b]	71.4[ef]	12.8
60	238[c]	19.3	10.95[a]	73.3[e]	15.8
90	201[d]	31.8	10.90[a]	75.1[e]	18.6
120	186[e]	36.9	10.97[a]	76.2[de]	20.3
150	159[f]	46.1	10.90[a]	76.8[de]	21.3
180	150[f]	49.1	10.90[a]	78.0[d]	23.2
With Phytase 0	289[a]	2.2	10.80[b]	71.3[ef]	12.6
30	240[c]	18.6	10.85[ab]	73.9[e]	16.7
60	205[d]	30.5	10.80[b]	77.2[d]	22.0
90	148[f]	49.8	10.95[a]	79.5[cd]	25.6
120	104[g]	64.7	10.90[ab]	81.2[bc]	28.3
150	87[h]	70.5	10.98[a]	82.6[ab]	30.5
180	70[i]	76.3	10.93[a]	84.9[a]	34.5
Sinn bread flour	414[a]	0.0	15.80[b]	60.8[g]	0.0
Without Phytase 0	392[ab]	5.3	15.91[a]	65.5[f]	7.7
30	380[bc]	8.2	15.77[b]	67.0[f]	10.2
60	362[c]	12.5	15.83[b]	69.1[ef]	13.6
90	340[d]	17.8	15.90[a]	71.2[de]	17.1
120	314[e]	24.1	15.76[b]	73.0[cd]	20.0
150	300[ef]	27.5	15.85[ab]	74.8[c]	23.0
180	281[f]	32.1	15.96[a]	76.0[c]	25.0
With Phytase 0	404[a]	2.4	15.83[b]	65.9[f]	8.4
30	351[cd]	15.2	15.90[a]	68.8[e]	13.2
60	307[e]	28.8	15.76[b]	72.2[c]	18.8
90	252[g]	39.1	15.88[ab]	74.6[c]	22.7
120	227[h]	45.2	15.96[a]	78.1[b]	28.2
150	188[i]	54.6	15.90[a]	80.8[ab]	32.9
180	152[j]	63.3	15.90[a]	82.2[a]	35.2

*** As in Table 2 .**

Conclusion

Adding *A. niger* phytase to wheat flours during breadmaking resulted in significant reductions in phytic acid content (up to 77% from the initial concentrations) , didn't cause any deteriorative effects on physical and

organoleptic properties of breads and increased the *in vitro* protein digestibility . From a processing and a nutrition point of view , it may beneficial to supplement wheat flours which are rich of phytate with phytase during breadmaking to overcome the possible deleterious effects of phytate .

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دور إنزيم الفيتاز في جودة ثلاثة أنواع من الخبز المصرى

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كان الهدف من هذا البحث دراسة مدى تحطم الفايتات وجودة ثلاثة أصناف من الخبز الواسعة الاستهلاك في مصر وهى (البلدي – الشامي – السن) كنتيجة لتأثير إضافة إنزيم الفيتاز (أسبرجلس نيجر) أثناء صناعة الخبز .

وقد تم تقدير كلا من التركيب الكيماوي التقريبي لدقيق استخلاص ٧٢% ، ٨٢% وكذا دقيق السن ، والخواص الفيزيقية للخبز ، والخواص العضوية الحسية للخبز ومحتوى الخبز من الرطوبة ورقم الحموضة pH ومحتوى حمض الفايتيك ، البروتين الخام والهضمية المعملية للبروتين ، وذلك لكل من الخبز غير المضاف / المضاف إليه إنزيم الفيتاز .

وقد أوضحت النتائج أن التركيب الكيماوي التقريبي للدقيق قد اختلفت معنوياً مع ارتفاع محتوى البروتين والمستخلص الإيثيرى الخام ، الرماد ، الألياف الخام وذلك لدقيق السن على النقيض من دقيق القمح استخلاص ٧٢% .

كما أظهرت النتائج أن إضافة إنزيم الفيتاز لم يؤثر على الخواص الفيزيقية والعضوية الحسية للخبز هذا وقد انخفضت قيم الحموضة pH ومحتوى حامض الفايتيك فى الخبز الناتج بزيادة فترة التخمير كما ضاعف إضافة الفيتاز من معدل انخفاض حمض الفايتيك حيث وصلت % لانخفاض تركيزات حمض الفايتيك إلى 38.2 ، 70.2 (البلدي) - 49.1 ، 76.3 (الشامي) – 32.1 ، 63.3 (السن) وذلك لتلك العينات غير المعاملة / والمعاملة بإنزيم الفيتاز على التوالي .

كما أوضحت النتائج أن إضافة الفيتاز قد حسن من الهضمية المعملية للبروتين حيث وصلت % للتحسن في الهضمية المعملية للبروتين إلى 37.8 ، 34.5 ، 35.2 لكل من الخبز البلدي والشامي والسن على التوالي .

2700 2701 2702 2703 2704 2705 2706 2707 2708 2709

2700 2701 2702 2703 2704 2705 2706 2707 2708 2709