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EFFECT OF ADDING SWEET POTATOE FLOUR TO WHEAT FLOUR ON THE PROPERTIES OF PAN BREAD.

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ABSTRACT

The present study was carried out to evaluate the replacement of 10, 20 and 30% of wheat flour (72% extract) in the same percentage of sweet potato flour to produce pan bread.

The results showed that:

- Bread produced from the addition of sweet potato flour lead to a decrease in the percentage of moisture and protein, where the results were 22.74%, 11.6%, respectively in the sample Control .And became 22.01%, 9.60%, respectively, in bread produced from the addition of 30% potato flour.
- Increased in crude fiber , ash and fat were 2.07%, 2.40% and 3.58%, respectively in the sample Control. Became 2.77%, 3.36% and 5.20% respectively in the bread produced from the addition of 30% sweet potato flour.
- It was also found during the study that 10% of the sweet e potato flour is the best ratios for the production of baked good in terms of Rheological and Sensory characteristics of the product, despite the decline for a sample Control.

Keywords: Sweet potato flour, pan bread, wheat flour, Rheological properties, chemical composition, Organoleptic evaluation).

INTRODUCTION

As a traditional and important food is the daily diet. Wheat bread was reported having increased consumption since 1995 Kihlberg*, et al,*(2004). Meanwhile, the demands for wheat-based products with value-added are growing rapidly in the past few decades Bhattacharya *et al,* (2003) *as* consumers realized that eating foods with health benefits is better than taking supplements Martin, (2005).

" Breads " made from non-wheat " flour," which contribute more nutrients than that from white or wheat "bread," are known as specialty "breads." In addition to the nutrients they provide, specialty "breads" contribute added flavor and color that may not be observed in most common "breads." Specialty "breads" are becoming more and more popular among consumers because of their nutritional value, flavor, and color attributes Brown, (1996).

Researchers agree that the sweet potato (*Ipomea batatas (*L.) Lam) is a highly nutritious, but under-utilized crop, which has potential for use in human food systems Van Hal, (2000); Walter*, et al.,*(2002). Although the sweet potato is an important staple food in many developing countries, its shelf-life is limited by moisture loss, rotting, sprouting or changes in sensory properties Ress *et al.,* (2003) Processing the sweet potato into value-added products, such as "flour" for use in specialty "breads," or as a substitute to wheat "flour," could be helpful in extending its shelf-life while increasing the intake of many nutrients.

The aim of this paper was to study the effect of substitution a part of wheat flour with sweet potato on rheological properties of dough and quality of produced pan bread.

MATERIALS AND METHODS

Materials:

- Wheat flour (72 % extraction) was obtained from Five Star Flour Mills-Industrial area Ataqa literary, Swiss.
- Sweet potato flour was obtained from safco company, Nasr city, Egypt**.**
- Fresh bakry compressed Yeast, Salt (sodium chloride) , Milk powder ,Suger and oil corn were obtained from the local market.

Methods:

Rheological properties:

Rheological characteristics of the wheat flour containing 10, 20 and 30% sweet potato flour, dough were assessed using the Barabender Farinograph and Extensograph according to the method described in the A.A.C.C. (2000). At Rheological Lab., Department of Bread and Dough, Food Technology Research Institute, Giza, Egypt.

Preparation of Pan bread:

Pan bread was prepared by straight dough method as described in A.A.C.C. (1983) as follows **:**

The ingredients consisted of wheat flour (1kg), water (500 g), dry yeast (15 g), salt (10 g), bread improver (10g), sugar (60 g), milk powder (20 g), and corn oil (60 g). The ingredients were mixed for 4 minutes at slow speed (30 r.p.m) and for additional 6 minutes at fast speed (60 r.p.m). The resulted dough was l*et* to rest for 20 min at 28 - 30°C (first proofing) then divided, rolled and molded automatically in a molding machine. Each piece was placed in metal pan and let to ferment for 60 min at 36°C (final proofing) then the baking process was carried out in electrically heated oven at 210-220°C for 15 - 20 min. After baking, loaves were separated from the metal pan and allowed to cool at room temperature before organoleptic evaluation.

Chemical analytical methods:

1. Determination of moisture ,ash, fat, crude fiber, crude protein and total calories according to A.O.A.C (2000).
2. Determination of carbohydrates was calculated by difference
   Total carbohydrates = 100 – (protein + fat + ash + fiber)
3. Determination of mineral contents (K, Fe, Zn, Ca and Mg) were determined in samples using a Perkin Elmer, Atomic Absorption Spectrometer model 3300 (made in U.S.A.). In Agriculture Research Center. Giza, Egypt as described by A.A.C.C. (1983)
4. Determination of amylase was determined according to the method described in Juliano (1971).

Physical properties of bread :

1. **Loaf weight :** was determined according to the method described in the A.A.C.C . **(**1994).

2. **Loaf volume** : was measured by bean displacement by method Greene and Bovell-Benjamin **(**2004) and Wang *et al*., **(**2002).

3. Specific volume : The specific volume of the bread was determined as shown in Eq. Penfield and Campbell, **(**1990):

Specific volume(Cm^3 /g) = Loaf volume of bread/weight of bread

Organoleptic evaluation:

Pan bread were organoleptically evaluated by 15 panelists from the staff of Food and Technology Institute Agriculture Research Center, Giza, Egypt. All samples were characterized for appearance, crust color, crumb color, taste, odour, grain, textur and volume. El-Ferra *et al* (1982).

Statistical analysis

Analysis of variance was applied to sensory evaluation of data of flat bread. Multiple comparisons were carried out using LSD Ott, (1988).

RESULTS AND DISCUSSION

Rheological properties:

Farinograph parameters of dough prepared by substituted wheat flour with sweet potato flour:

The results presented in Table (1) and illustrated in Figures (1) showed the effect of substitution of wheat flour (72 % extraction) with 10, 20, and 30% of sweet potato flour on Farinograph parameters .

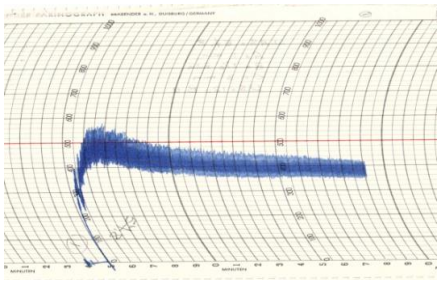
From the obtained data, it could be noticed that the water absorption was increased from 57.2% for control sample (100% wheat flour 72% extraction) to 65.5, 73.3 and 77.6% as a result to addition of 10, 20 and 30% of sweet potato flour, respectively to wheat flour.

Trends of the change in arrival time and dough development time of blended dough were not clear with increasing the levels of replacement wheat flour with sweet potato flour and were fluctuated.

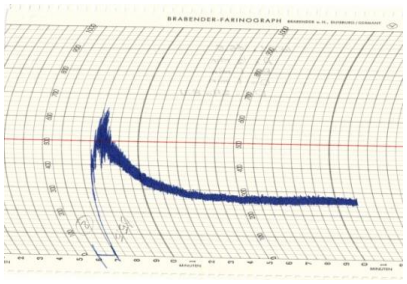
Dough stability time is an important index for the dough strength based on the quantity and quality of dough gluten, so it could be observed that the stability time of wheat flour dough was decreased from 3.0 min. for control sample to 0.5 as a result to substituted of wheat flour (72% extraction) with 30% of sweet potato flour. The decrement in the stability time indicates weakness of dough strength. This weakness of the dough might be due to the dilution of wheat gluten content (dilution effect) as a result to addition of the sweet potato flour to wheat flour. These suggestion is agree well with Ciacco and DÓAppolonia (1977) and Nada (2009).

Table (1): Effect of addition of Sweet potatoe flour to wheat Flour (72%extraction)(WF) on Farinograph parameters:

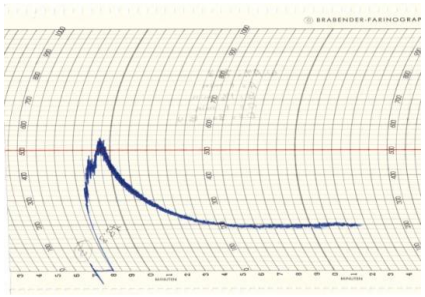
Samples	Water absorption %	Arrival time (min.)	Dough development (min.)	Dough stability (min)	Degree of weakening (B.U.)
WF(72%)Cont.	57.2	1.0	1.5	3	120
10%	65.5	0.5	1.0	1	240
20%	73.3	1.0	1.5	1	300
30%	77.6	1.5	2.0	0.5	330



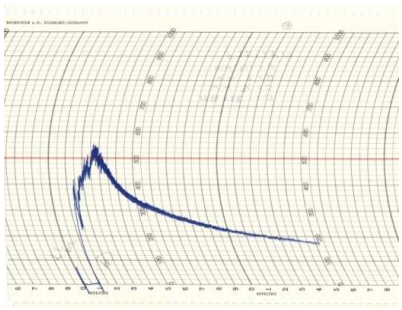
Control sample
(100% wheat flour 72% extraction)



90% wheat flour + 10% sweet potato flour



80% wheat flour+ 20% sweet potato flour



70% wheat flour + 30% sweet potato flour

Fig. (1): Effect of substituted wheat flour (72% extraction) with 10, 20 and 30% sweet potato flour on farinograph parameter.

They mentioned that the farinogram stability in most cases decreased with an increase in wheat flour dilution, indicating an overall weakening of the dough. This damage can be explained on the basis of dilution gluten portion, which probably delirious binding strengthens of the gluten net.

Extensograph parameters of dough prepared by substituted wheat flour with sweet potato flour:

Data presented in Table (2) and illustrated in Figure (2) showed the effect of substitution of wheat flour (72 % extraction) with 10, 20, and 30% of sweet potato flour to wheat flour on Extensograph parameters .

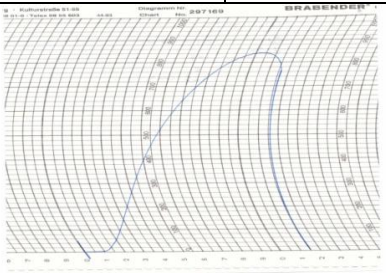
From the obtained data, it could be noticed that the resistance to extension were decreased from 840 B.U for control sample to 570, 360 and 240 B.U, respectively. This may be due to the dilution of wheat gluten as a result to addition of the sweet potato flour to wheat flour.

On the other hand, data in the same Table show that the values of the extensibility of wheat flour dough was increased as a result to addition of sweet potato flour to wheat flour flour were 110(mm) ,115(mm) and 127(mm) which containing 10, 20 and 30% of sweet potato flour, respectively in compared with 105 (mm) for wheat flour dough (Control sample).

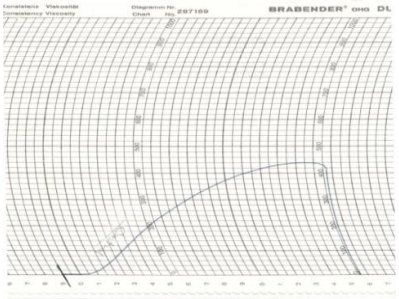
Concerning to the proportional number. The results in the same Table showed that the values of proportional number were slightly decreased as a result to addition of sweet potato flour.from 8 for control sample to 5.2 , 3.1 and 1.9 for samples which containing 10, 20 and 30% of sweet potato flour, respectively.

Table (2): Effect of addition of Sweet potatoe flour to wheat Flour (72%extraction)(WF) on Extensograph parameters:

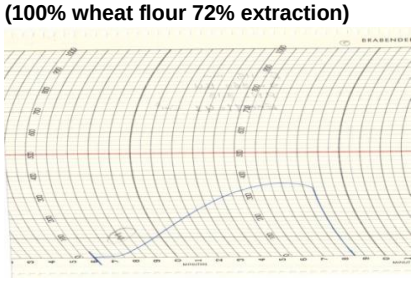
Samples	Resistance to extension (B.U.)	Extensibility m.m.	Proportional number (R /E)	Energy cm²
WF(72%)Cont.	840	105	8	125
10%	570	110	5.2	63
20%	360	115	3.1	43
30%	240	127	1.9	33



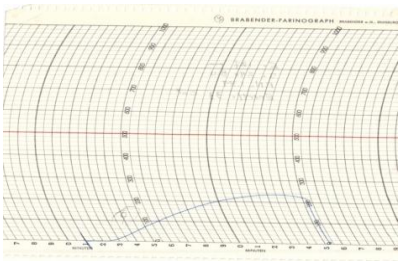
Control sample
(100% wheat flour 72% extraction)



90% wheat flour + 10% sweet potato flour



80% wheat flour + 20% sweet potato flour



70% wheat flour + 30% sweet potato flour

Fig. (2): Effect of substituted wheat flour (72% extraction) with 10, 20 and 30%sweetpotato flour on extensograph parameter.

Concerning to the energy, the control sample recorded the highest value being 125 cm^2, while other treatments were lower in the energy values. It was 63, 43 and 33 cm^2 for samples which containing 10, 20 and 30% of sweet potato flour, respectively. These results agree with Ally(2001) .

Chemical composition of raw materials:

The chemical composition of wheat flour (72% extraction rate) and sweet potato flour used in this investigation are shown in table (3). It is quite clear that moisture content, crud protein ,crud fat ,crud fiber ,ash ,total carbohydrat and total calories were 12.00%, 11.28%, 0.63%, 0.89%, 0.50%,

86.7% and 397.59 cal/100g in wheat flour (72% extraction rate) ,respectively. and 10,30%, 5.46%, 1.00 %, 5.17%, 3.42%, 84.95% and 370.64 cal/100g in sweet potato flour, respectively.

Data in table (3) also show that sweet potato flour the low content of amylose (17.49%) and wheat flour (72% extraction) (28.41%). These result agree with Mais (2008), who found that sweet potato flour are low in amylose. While the amylopectin content in sweet potato flour (82.51%) and in wheat flour (72% extraction) (71.59 %).

Data presented in same table (3) shows the mineral content (Zn, Fe, Ca, K and Mg) of wheat flour 72% and sweet potatoes flour (mg/100g dry weight).

From the results , it can be noticed that the mineral content were Zinc (Zn), Iron (Fe), Calcium (Ca), Potassium (K) , Magnesium (Mg) contents were in wheat flour (72% extraction) 0.99 ,3.54 ,46.59 ,257.68 and 71.17 (mg/100g), respectively. And in sweet potatoes flour were 1.07, 6.16, 107.91 ,1235.01 and 183.46 (mg/100g), respectively. These results agree with Ally (2001). He found that sweet potato flour have high value in the mineral content compared with wheat flour 72%.

Table(3): Chemical composition of raw materials (wheat flour 72% and sweet potatoes flour)(on dry weigt basis).

Constituents(%)	Wheat flour 72%	Sweet potatoes flour
Moisture	12.00	10.30
Protein	11.28	5.46
Fat	0.63	1.00
Crud Fiber	0.89	5.17
Ash	0.50	3.42
Carbohydrate	86.7	84.95
Total calories	397.59	370.64
Amylose	28.41	17.49
Amylopectin	71.59	82.51
Zn(mg/100g)	0.99	1.07
Fe	3.54	6.16
Ca	46.59	107.91
K	257.68	1235.01
M g	71.17	183.46

Chemical composition of pan bread :

The data illustrated in table (4) shows the chemical composition of pan bread prepared from wheat flour (72% extraction rate) and its mixture.

The moisture content, crud protein , crud fat, crud fiber ,ash and total carbohydrates were found to be 22.74%, 11.61%, 3.58%, 2.07%, 2.40% and 80.34% in control to 22.01 % , 9.60% , 5.20%, 2.77%, 3.36% and 79.07% in blend at replacement level 30% of sweet potato flour, respectively. These results agree with Ally (2001) and Nada (2009). They mentioned that the moisture and crud protein contents were decrease, while crud fat, crud fiber and ash were increase by added sweet potato flour.

The total calories was found to be 400.02 cal/100g bread (dry weight basis) in control. It was found to be 401.48 cal/100g in blend at replacement level 30% of sweet potato flour.

From the same table it could be noticed that amylase content was 27.93% in control. It was decreased to 24.35% in blend at replacement level 30% of sweet potato flour. While the amylopectin content was increased from72.07% in control to 75.65% in blend at replacement level 30% of sweet potato flour, respectively. These results agree with Mais (2008). who found that the bread content of sweet potato flour are low in amylose.

Data presented in same table (4) shows the mineral content (Zn, Fe, Ca, K and Mg) of pan bread (mg/100g dry weight)

From the results , it can be noticed that the mineral content were gradually increased in blend at replacement levels 10%,20% and 30% of sweet potato flour respectively,with compared to control.

Zinc (Zn), Iron (Fe), Calcium (Ca), Potassium (K) , Magnesium (Mg) contents were found to be 1.17, 5.04, 278.34, 419.37 and 79.28 mg/100g in control, respectively. It was increased to 1.76 , 7.01, 314.30, 495.0 and 101.69 mg/100g in blend at replacement level 30% of sweet potato flour, respectively.

Table (4): Chemical composition of pan bread (on dry weigt basis)

Constituents(%)	p.b Cont.	10%	20%	30%
Moisture	22.74	22.48	22.37	22.01
Protein	11.61	11.56	10.53	9.60
Fat	3.58	4.73	4.85	5.20
Crud Fiber	2.07	2.31	2.66	2.77
Ash	2.40	2.88	3.00	3.36
Carbohydrate	80.34	78.52	78.96	79.07
Total calories	400.02	402.89	401.61	401.48
Amylose	27.93	26.88	25.19	24.35
Amylopectin	72.07	73.12	74.81	75.65
Zn(mg/100g)	1.17	1.42	1.67	1.76
Fe	5.04	5.47	5.69	7.01
Ca	278.34	289.8	302.25	314.30
K	419.37	468.58	480.88	495.0
M g	79.28	83.76	85.76	101.69

Loaf volume:

Table (5) shows the effect of replacement of wheat flour (72% extraction rate) by different levels of sweet potato flour on the specific volume of pan bread.

Table (5): Effect of replacement of wheat flour (72% extraction) (WF) by different addition from sweet potatoes flour on the specific volume of pan bread.

Samples	Weight (gm)	Loaf volum $(cm)^3$	Specific Volum (cm^3/g)
100% wheat flour(72%)Control	170.95	625	3.66
10% swf + 90% wf 72%	167.54	500	2.98
20% swf + 80% wf 72%	192.71	515	2.67
30% swf + 70% wf 72%	161.5	255	1.58

Results in table (5) shown that replacement of wheat flour by different levels of sweet potato flour lead to decreased of specific volume from 3.66 (cm^3/g) in control to 2.98 , 2.67 and 1.58 (cm^3/g) in blend at replacement levels 10% , 20% and 30% of sweet potato flour, respectively.

These results agree with Wu et al.;(2009) who found the Loaf volume significantly decreases with the addition more than 20% of sweet potato flour low loaf volumes were expected because sweet potato is soft with low gluten content and rich in fibre and thus the loaf reflect the gluten content of the bread Greene and Bovel-Brenjamin (2004).

Organoleptic evaluation of pan bread and its blends :

Pan bread made from wheat flour (72% extraction) and its blends at replacement levels 10% , 20% and 30% of sweet potato flour were evaluated by 15 panelists for their sensory characteristics such as Appearance, Colour of crust, Colour of crumb, Taste, Odour, Grain,Texture, Volume and Overall acceptability.

The mean values were statically analyzed using analysis of variance and least significant difference (LSD) as shown in table (6).

From the same table it could be noticed that control sample had the highest overall acceptability scour (97.6%) followed by sample with 10% (88.6%) , sample with 20% (80.8%) and the sample with 30% of sweet potato flour had the lowest values of overall acceptability was (72.8%).

Table (6): Statical analysis of sensory evaluation for Pan bread(P.b):

Samples	Appearance	Colo of crust	Colorof crumb	Taste	Odour	Grain	Texture	Volume	overall
P.bCont.	4.8a	9.6a	9.8a	13.8a	14.4a	19.8a	19.8a	5.0a	97.6a
10%	4.4a	8.6b	8.6b	12.6a	13.8ab	17.4ab	18.4a	4.2ab	88.6b
20%	4.0a	8.4b	8.0b	12.2a	13.0ab	15.6b	16.0b	3.4b	80.8c
30%	2.8b	7.2c	7.2c	12.2a	12.0b	15.2b	14.4b	3.2cb	72.8d
LSD	0.9871	0.9714	0.7343	3.4116	2.1722	2.6392	2.0985	0.87405	6.19868

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تأثير اضافة دقيق البطاطا لدقيق القمح على خواص خبز الفينو

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تم دراسة استبدال ١٠و٢٠و٣٠% من دقيق القمح (٧٢% استخلاص) بنفس النسب من دقيق البطاطا لانتاج خبزفينو واظهرت النتائج ان :

الخبز الناتج من اضافة دقيق البطاطا ادى لانخفاض فى نسبة الرطوبة والبروتين حيث كانت النتائج ٢٢.٧٤% ، ١١.٦% على التوالى فى العينة الكنترول. وأصبحت ٢٢.٠١%، ٩.٦٠% على التوالى فى االخبز الناتج من اضافة ٣٠% دقيق البطاطا.

كما اظهرت النتائج زيادة فى كل من نسبة الالياف والرماد ووالدهون حيث كانت ٢.٠٧%، ٢.٤٠% و ٣.٥٨% على التوالى فى العينة الكنترول. واصبحت ٢.٧٧%، ٣.٣٦%و٥.٢٠% على التوالى فى االخبز الناتج من اضافة ٣٠% دقيق البطاطا.

واتضح ايضا من خلال الدراسة ان ١٠% من دقيق البطاطا تعتبر افضل النسب لانتاج خبز جيد من حيث الصفات الحسية والريولوجية للمنتج رغم انخفاضها عن عينة الكنترول.

قام بتحكيم البحث

أ.د / محمد طه شلبى	**كلية الزراعة – جامعة المنصورة**
أ.د / طلعت محمد سحلول	**كلية التربيه النوعيه بدمياط – جامعة المنصوره**