EFFECT OF SUBSTITUTING RICE MEAL BY SWEET POTATOES , WHEAT AND BARLEY FLOUR ON RICE BREAD PRODUCING .

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ABSTRACT

In order to get a wide variety of nutrients on our daily consumption of bread, avoid metabolic syndrome cases, to face climate change, and Bio-fuel which planted for producing it from grains, and cultivate Gatropha plant. The local different carbohydrates of cereals are solution. Replace as many refined carbohydrates of whole grains of rice meal, barley flour, and sweet potatoes as vegetable carbohydrates were studied. Barley yields of hulls, bran, and total flour of three cultivars milled from seeds and whole grain (de hulling by rice polisher machine) were studied. The total flour yield obtained from seeds had a range 58.65 – 57.64 %. Where, the total flour yield obtained from whole grains had a range 73.72 – 78.44 % .The de hulling of barley by rice polisher machine before milling increased flour yield , decreased yield of bran , and of course affected the chemical and physical properties of flour . Replacement of 15 % rice flour by barley flour resulted in softer rice bread and the color of the final product become moderate.

Sweet potatoes are still not substitutes for bread making. In this studies the replacement was an appropriate ratio from a low degree of gelatinization with activates enzymes (heat stable α-amylase) which leads to the smooth texture, sweet flavor, reduce energy consumption of gelatinization, a void rubbery bread, and a new source of vegetable carbohydrates. The effect of all ratios rice flour by gelatinized sweet potatoes (GSP) levels resulted in softer bread especially after 48 hr. of storage .This may be related with keeping water of GSP for along time. This replacement of GSP could be potential new physical member of hydrocolloids.

Organoleptic properties of the best selected blendes indicate that 55% G&NGRF(35% G + 65% NGRF)+ 20 % wheat flour +15 %

barley flour +10%GSP , can be recommended to use for human consumption .

INTRODUCTION

Climate change is projected to have a significant impact on European and global food and feed markets.

Bio-fuel from grains which take place in Brazil which produce 16.5 Milliard Letter (45.2% from national production). Also, United State, which produce 16.2 Milliard Letter. European Union produces 90% from national markets for Bio-diesel. United State mixes Methanol with Benzene to avoid toxic materials .European, Canada, and Japan work to" Keoto " protocol to avoid Co2.

The farmers of the third world state exchange Gatropha plant, which produce high efficient performance in Bio-Fuel instead of grains. Gatropha is a useless desert plant when its seed burn gives 20% from Co2 as compared with Petrol. On 2010 year the European law, every fuel-consumer on any way must consume about 5.75 % of its total consumer Bio-Fuel. This ratio well ascending to 20 % on 2020 year.

Generally all carbohydrates get broken down in the body into a simple sugar called glucose. This is a good thing, since glucose is the principal fuel that powers our bodies and brains. But some people – have trouble regulating their glucose level .The hallmarks of this condition ,which nutritionist now call metabolic syndrome, include a big waist (100 cm or more for men , 88 cm or more for women),high blood pressure (more than 130 /85 Hg),a predisposition toward diabetics and troubling cholesterol levels in the blood . Doctors are not quite sure exactly why the body sometimes reacts this way, though they know that syndrome is exacerbated by a sedentary life style. Hence their No .1 recommendation for patients with metabolic syndrome is to get more exercise and build muscle mass. But they also now advise them to replace at least some of the refined carbohydrates in their diets, in order to get a wide variety of nutrients.

Our goal should be to eat at least five or four servings of cereals in our daily bread. Then the different carbohydrates of cereals is solution .They are the staff of life .We should replace as many refined carbohydrates as we can with whole grains such as brown rice, barley and whole-grain flours . There are ascending orders of cereals processing:-

***Whole grain:** Only outer husk is removed.
***Cracked or steel cut:** Grains are cut into pieces.
***Flaked or rolled:** Kernels are flattened by rollers.
***Flour:** Whole or polished grains are ground into powder.

Wu *et al* (1994) and Yoon *et al* (1995) reported that barley was milled using a pin or hammer mill for both types of milling, the abrasion step was required to remove the hull of the barley kernel. Abrasion results significant losses of the outer layer of the endosperm, which contains a high level of vitamins and essential amino acids (**Bhatty, 1997).** Also, the possibility of using a pin mill is producing a high rate of starch damage in flour (**Nowakowski *et al* (1986)** . Milling of barley using a roller-milling resulted in poor separation of the bran and barley flour was less free –flowing than wheat flour, which affected its sieving properties **(Bhatty , (1996) .**

The development of improved method for milling barley is one of the most important objectives for milling recovery. Milling yield of rough barley is the estimate of the quantity of head barley and of total milled barley that can be produced from a unite of rough parley.

In these modern articles we need to support our bread by a local product mixture as much as possible. Sweet potatoes (*Ipomoea batatas*) adding have the latest innovative solutions to achieve a source of vegetable carbohydrate to avoid metabolic syndrome. Sweet potato and potato flour are suitable for use as an extender of wheat flour in bread making (Dendy *et. al.,* 1970) . This would be important in wheat lack countries, and depending on importing large quantities of it or its flour (El-Nemr and Fahmy,1979).

For improved technologies, as measured against specific indicators of safety, quality and sustainability are expected. Consumer acceptance is a strong reason for action in this field.

The food industry's most frequently used hydrocolloids include: agar, alginates, Arabic, carrageen an, car boxy methyl cellulose (CMC), gelatin, konjac flour, Locust bean gum (LBG), methyl cellulose and hydroxy propyl methyl cellulose (MC/HPMC), microcrystalline cellulose (MCC), pectin, starch, and xanthan.

Our early studies promising that sweet potatoes could be potential new member of this team in bakery products and may be mouth feel enhancers in rice bread.

The aim also, is to identify and characterize traditional technologies in developing anew loaf of bread. Consumer acceptance

is a strong reason for action in this field. The bread with high quality potential by local raw materials, and all people and governorates will be the greatest beneficiaries of improved rice bread.

MATERIALS AND METHODS

1–Materials:

Rice: The improvement materials used in this investigation were broken rice, resulted from commercial rice milling which was converted into flour by a local stone mill. Also, brown rice (whole grains) which only husk removed and rich on nutrients component were converted into flour by the same manner.

Barley: The source of barley were obtained from, Crops Research Institute, Agric .Research Center. Three varieties of barley named Giza 123, Giza 126, and Giza 2000.

Wheat flour: Wheat flour 86 % extraction , were obtained from Kafr – El –Sheik Company of milling .

Sweet potatoes: were obtained from local market.

Selection: Choose firm, dark, smooth sweet potatoes without wrinkles, bruises, sprouts, or decay. Even if cut away a decayed spot may have already caused the whole potato take on an unpleasant flavor.

Storage: Sweet potatoes spoil rapidly. To keep it fresh, store in a dry, cool place such a cellar, pantry, or garage . Don't in the refrigerator, where they will develop a hard core and an of taste . If stored properly, it will keep for a month or longer. At normal room temperature, they should be used within a week of purchase. We do not wash it until tubers cooked.

2-Methods:

Gelatinization of rice flour: Rice flour was gelatinized according to **Agag and Abdeen**, (1999) methods.

Barley flour: Barley flour was prepared by innovated method. Tow separate methods was used to raise the extraction rate about 80%. The hulls were removed by rice polisher machine as abrasion step. Then, whole grains were grinder in cylinder mill to obtain the flour.

Sweet potatoes: Wash sweet potatoes well, cut them whole whenever possible as most of the nutrient is next to the skin. Place potatoes in a pan and cook them in boiling water for 20 min. or until a level of

tender with activates enzymes(α-amylase) which subsequently transform starches present in the sweet potatoes to α-starches which lead to the smooth texture . According the method of **(Lee and Kim, 1990).**

Preparation of bread : The bread was baked using the following ingredients: Three independent variables, at three levels (%) wheat flour, barley flour, and gelatinized sweet potatoes as the following experimental design Table (1) were added as percent , 35% gelatinized and 65% non gelatinized rice flour as rice bread basses .

Table (1). The three variables at three variations as percent added to gelatenized&nongelatenized rice flour. (From 45 – 65 %) as rice bread basses.

Variables	Variation			
	-1	0	+1	Cod
Wheat flour	15	20	25	WF
Barley flour	10	15	20	BF
Gelatenized sweet potatoes	5	10	15	GSP

Three independent variables (wheat flour, barley flour, and gelatinized sweet potatoes) at three- level with three replicates, at the center point were used. The outline of the test conditions design was given in Table (2).

Table (2).The out line of the experimental design.

Variables	Test condition														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
WF	-1	+1	-1	+1	-1	+1	-1	+1	0	0	0	0	0	0	0
BF	-1	-1	+1	+1	0	0	0	0	-1	+1	-1	+1	0	0	0
GSP	0	0	0	0	-1	-1	+1	+1	-1	-1	+1	+1	0	0	0

All ingredients were mixed in electric Lab. Kneading for 5 min. at 120 rpm and after cooling dough to 40°C, the yeast were added and mixed for 1 min. After 30 min. The dough was immediately transferred to cutting machine and bath through two rolling machine then into fermented room for 15 min. The bread was then baked in gas oven for 5 min at 380° C.

We can put the total out line for all ingredients percent as following in Table (3).

Table (3). The out line for rice bread ingredients % per Kg.

Variables	The out line of the experimental design for all ingredients as %														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
G&NGRF	65	55	55	45	65	55	55	45	65	55	55	45	55	55	55
WF	15	25	15	25	15	25	15	25	20	20	20	20	20	20	20
BF	10	10	20	20	15	15	15	15	10	20	10	20	15	15	15
GSP	10	10	10	10	5	5	15	15	5	5	15	15	10	10	10

G&NGRF = Gelatinized and non gelatinized rice flour.
WF = Wheat flour 86 % extraction rate.
BF = Barley flour.
GSP = Gelatinized sweet potatoes.

After baking, bread was removed from the oven, cooled to room temperature , volume and hardness were evaluated .

Loaf volume: The volume of bread loaf was determined by rapeseed displacement.

Hardness: Hardness of bread was evaluated using a texture analyzer (TA- XT2, Stable Micro System, Godalming, and Surrey, UK).According to the method of (Klamczynski and Czuchajowska, 1999). Two bread slices (4o mm thick) were taken from the middle of the loaf. One slice was measured after 2 hr from baking (fresh). The second slice was covered with a plastic bag and stored at 4C .Hardness was determined after 48 hr of storage. A slice of bread was compressed with a stainless steel probe 12.5 mm in diameter to 25% strain. Compression speed was 1 mm/ sec. The compression force was recorded and results expressed in Newton (N).

The measurements were taken in the central part of the slice. Each slice was compressed once. Slices from two breads were considered as one replicate.

Quality evaluation of produced bread: The quality of produced rice bread was evaluated by 10 members of consumer with a scoring system developed by **El-Nemr (1976),** the maximum score was 50, and the of acceptability was 30 scores.

RESULTS AND DISCUSSION

The yields of hulls, bran and total flour, of three barley cultivars, hulled and dehulled kernels were milled as presented in

Table (4). The total flour yield obtained from whole grain had a range 73.72- 78.44%. Where, the total flour yield obtained from barley kernels had a range 58.65- 57. 64 %. This was particularly evident when the flour was milled from whole grain (after de hulling by rice polisher machine). Lower flour yield of 30.3 % was reported by **Wang *et al.* (1993)**, who milled seeds of barley. Also **Bhatty, (1996)** found that tempering of barley did not affect the total flour yield.
A high yield of barley flour (78.44 %) was produced from Giza 2000 variety (Table 4). The de hulling of barley by rice milling polisher machine before milling, increased flour yield, decreased yield of bran, and of course affected the chemical composition and physical properties of flour.

Table (4) .The extraction rate of flour from kernels and whole barley grains.

Varieties of barley	Hulls %		Bran %		Extraction rate	
	kernels	Whole	kernels	Whole	kernels	Whole
Giza 2000	29.18	15.75	13.18	5.81	57.64	78.44
Giza 123	28.08	18.21	12.24	6.14	58.96	75.65
Giza 126	27.13	21.30	14.22	4.98	58.65	73.72

The extraction rate of barley kernels are less than extraction rate of whole barley grains. The bran sifted from whole kernels (de husk grain) was much lighter in color and consisted mostly of cell wall material of the endosperm. While bran milled from barley seeds was visually darker in color and contained mostly seed coat and aleurone layer. The aleurone layer, which attached with coat and husk are difficulties of separate. Therefore, a low yield of barley flour was produced from milled barley seeds.

Table (5). Showed that replacement of 15 % rice flour by barley flour resulted in softer rice bread, both freshly baked and after 48 hr. of storage, without decreasing the loaf volume. When we added barley flour (dark color) to rice flour (white color) the color of the final products become moderate.

Sweet potato based bread currently available .These product include whole sweet potatoes. While these commercially an available products enjoy some consumer acceptance , these are still not substitutes for ,nor do they provide a crispy ,crunchy and light texture comparable to that found in consumer preferred wheat bread . Such as

sweet products with high reducing sugars during cooking become rubbery and to bring them to the glassy state requires more energy, that is, they must be cooked at very high temperature. Increasing the temperature causes the product to burn or caramelized, with the resulting off-flavor and bitter taste. Therefore, the manufacture faces the option of either a low degree of gelatinization, which retains the flavor but does not provide the requisite crispness, or more gelatinization to make it crispy, but with a burnt flavor. Thus, the addition was appropriate ratio from a low degree of gelatinization with activates enzymes α - amylase which subsequently transform starches present in the sweet potato to α – starches which lead to the smooth texture. Also enhances the activity of β – amylase present in said sweet potato to increase the amount of maltose produced and bring out the mellow, sweet flavor that is desired most in the sweet potato. Many attempts have been done to reduce energy consumption of gelatinization and liquefaction of the starches. **Brooks and Greffin (1987),** utilizing a heat stable α-amylase, **Lee and Kim (1990),** Studied the gelatinization and liquefaction rate of sweet potato by heat stable α-amylase , **Abu El-Azm, (1999),** reported that gelatinization and liquefaction 20% of wheat and corn starch solution at 90 C for 45 : 60 sec. only by using thermal stable α- amylase. Therefore, we used α-amylase to reduce energy consumption of gelatinization, facilitate the replacement, obtained smooth crumb and crust for produced bread, and finally to avoid rubbery bread.

Replacement of 5, 10, and 15 % rice flour by GSP as vegetable carbohydrates source , local products ,high productive 13 Ton /Fed . Enhanced the golden color in rice bread. Addition of GSP an appealing golden yellow color in the produced bread, and yielded the highest volume, which was significantly different from the other **(Agag and Abdeen (1999),** products 100 % rice bread. This ,replacement promise that GSP could be potential new member of the previous hydrocolloids .The effect of all adding level resulted in softer bread especially after 48 hr. of storage. This observation may be related with the keeping water of GSP for along time. Also, this belongs the staling of rice bread. **Bechtel and Meisner (1954),** concluded that bread with higher moisture content was significantly fresher than bread with lower moisture. As expected, samples with different replacement levels produced different loaf volumes Table (5). Bread with higher loaf volumes obtained from Exp. No. 13- 15

(center point) were softer and remained softer during storage than did breads with lower volume (as compared with control) .**Axford *et al* (1968)**, studied the effect of loaf volume on the rate of staling and found that lower specific volume increased the staling rate and higher specific volume lowered it .

Table (5). Moisture, volume, and hardness of substitutions rice flour by gelatinized sweet potatoes and wheat, barley flour.

Experimental No.	Moisture content after hr.		Volume Ml	Hardness (N)	
	1 hr. Fresh	48 hr.		1 hr. Fresh	48 hr.
100% rice bread (control)	30.30	26.00	509	5.07	6.80
Exp. No. 1	34.80	31.50	692	4.71	5.66
Exp. No. 2	35.90	33.20	679	4.78	5.68
Exp. No. 3	34.30	32.90	691	3.90	4.59
Exp. No. 4	34.60	32.90	687	3.65	4.33
Exp. No. 5	33.80	31.90	689	4.62	5.40
Exp. No. 6	34.50	32.10	691	3.85	4.60
Exp. No. 7	33.40	31.20	688	4.50	5.32
Exp. No. 8	35.20	33.30	690	3.72	4.81
Exp. No. 9	35.00	33.90	671	4.55	5.10
Exp. No. 10	33.20	31.90	668	4.43	5.02
Exp. No. 11	34.50	32.80	677	4.37	5.40
Exp. No. 12	34.70	32.80	680	4.88	5.30
Exp. No. 13	37.20	36.00	720	3.00	3.30

Regardless to produced breads , volume, crust color , Texture ,and crumb had the highest score among the other proportion as compared with control . In addition, they were the most effective factor on the final product acceptability (Table 6 and 7). However, the other properties were good enough to be quite acceptable by the consumer.

Table (6). Organoleptic properties of produced bread.

Samples and Exp.No.	Volume	External surface	Crust color	Texture	Crumb	Eating quality	Total score
Rice bread(control)	7.5	8.0	3.0	3.5	3.0	12.5	37.5
Exp. No. 1	8.5	8.5	4.5	3.5	3.5	12.0	40.5
Exp. No. 2	8.5	8.5	4.5	3.5	3.5	13.5	42.0
Exp. No. 3	8.0	8.0	3.5	4.0	4.0	12.5	40.0
Exp. No. 4	8.5	8.0	3.5	4.5	4.0	12.5	41.0
Exp. No. 5	8.0	7.5	3.5	4.0	4.0	12.0	39.0
Exp. No .6	8.5	8.5	4.5	4.5	3.5	12.5	42.0
Exp. No.7	8.5	8.5	3.0	3.5	4.5	12.0	40.0
Exp. No. 8	8.5	8.5	4.5	4.5	4.0	13.0	43.0
Exp. No. 9	8.5	8.5	4.0	4.0	4.0	13.0	42.0
Exp. No. 10	8.0	8.5	3.5	3.5	3.5	12.0	39.0
Exp. No. 11	8.0	8.0	4.5	3.5	3.5	12.5	40.0
Exp. No. 12	8.5	8.0	3.5	4.0	3.5	12.5	40.0
Exp. No. 13	10.0	9.0	5.0	5.0	5.0	14.0	48.0
Exp. No. 14	9.5	10	5.0	4.5	5.0	14.0	49.0
Exp. No. 15	10.0	9.0	5.0	5.0	5.0	13.0	47.0

Apparent also from the same Tables that there are significant differences between the tested samples at $p< o.o1$, where breads with edible color was the most acceptable samples. But bread without color gave products that are gaudy and unnatural looking. It can be concluded that our studied product was quite acceptable by the panelists besides keeping moderate amount of nutritional compounds.

Table (7). Analysis of variance between properties , samples , and replicates of produced breads .

Source of variation	d.f	S.S	F
Between properties Volume, external surface, crust color, texture, crumb, eating quality.	6	35	3.30**
Between samples 100%rice bread &Blend 1-15	15	81.15	5.40**
Between replicates 20 panelists .	19	79.30	3.40

Where, d.f = Degree of freedom.
M.S. = Mean of square .
S. S = Summation square .
** = $p< 0.01$.

ACKNOWLEDGMENTS

We wish to thank the Agriculture Research and Development Council (ARDC),for a financial support .

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الملخص العربي

تأثير إحلال نسب من البطاطا ودقيق القمح والشعير على رغيف الأرز الناتج

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قسم الخبز والعجائن معهد بحوث تكنولوجيا الأغذية– مركز البحوث الزراعية – الجيزة.

تمت هذه الدراسة لعدة أغراض وهى الحصول على مجال واسع من المواد الغذائية في خبزنا اليومي وتجنب مجموعة أعراض أمراض التمثيل الغذائي ومواجهة التغيرات المناخية والوقود الحيوي الذي تم التخطيط لأنتاجة من الحبوب والاهتمام بزراعة نبات الجاتروفا . حيث يكمن الحل في استخدام جميع الغلال المتواجدة لدينا محليا. فضلا عن استخدام البطاطا كمصادر متنوعة من كربوهيدرات الخضر.

أجريت الدراسة بإحلال دقيق الحبوب الكاملة للأرز بدقيق القمح والشعيروالبطاطا المجلتنة لتحقيق هذه الأغراض .

تم إجراء عمليات طحن لثلاثة أصناف من الشعير لكل من البذور والحبوب الكاملة (بذور منزوعة القشرة الخارجية- بماكينة ضرب وتبييض الأرز) واتضح أن معدل الاستخلاص للحبوب الكاملة (٧٣,٧٢- ٧٨,٤٤ %) أعلى بكثير من معدل الاستخلاص لطحن البذور(٥٨,٦٥ - ٥٧,٦٤) وأن طحن الحبوب كاملة (منزوعة القشرة) يزيد من كمية الدقيق الناتج ويقلل من النخالة وبالطبع يؤثر على التركيب الكيماوي والخصائص الفيزيائية للطحين الناتج . ووجد أن إحلال ١٥ % من دقيق الأرز بدقيق الشعير أدى إلى طراوة وتحسين لون الرغيف .

أمكن أيضا إحلال دقيق الأرز بكميات مناسبة من البطاطا المجلتنة في وجود إنزيم الألفا أميليز الثابت حراريا والذي يقوم بتحويل النشا إلى الوضع ألفا وتسبيلة فيسهل من عمل بيتا أميليز المتواجد ويقلل من حرارة الجلتنة ويحسن الطعم والمذاق الحلو ويمنع التحبب في الرغيف الناتج . إن إحلال البطاطا المجلتنة بهذه الطريقة قد تعطى كل الاحتمالات لاستخدامها ضمن فريق hydrocolloids الطبيعية التي تضاف للمخبوزات بغرض التحسين حيث أعطت رغيف متميز في اللون والطراوة . كما أظهرت الخصائص العضوية الحسية أن تجارب الخبيز رقم ١٣- ١٥وهى عبارة عن ٥٥% أرز مجلتن وغير مجلتن (٣٥ % مجلتن +٦٥ % غير مجلتن) +٢٠% دقيق قمح+ ١٥ % دقيق شعير + ١٠ % بطاطا مجلتنة أعطت أفضل النتائج من حيث الطعم واللون والقوام والطزاجة وقبولة لدى المستهلك .