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UTILIZATION OF DEFATTED BLACK RICE BRAN IN WHEAT BREAD PREPARATION FOR ENHANCING NUTRITIONAL AND FUNCTIONAL PROPERTIES

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ABSTRACT

This study was carried out to produce bread fortified with defatted black rice bran (DBRB). The effect of incorporation of DBRB at different levels (5, 10, 15 and 20 %) on the quality characteristics of bread including rheological properties, sensory attributes, chemical composition and minerals were evaluated. Biological effect was also measured. The results indicated that DBRB had better nutrient profile, breads with 5,10,15% and 20 % was found to be acceptable specially bread containing 5, 10% DBRB. The dietary fiber, ash and protein contents were increased, while moisture, fat and carbohydrates contents were decreased with increasing of DBRB levels. The results revealed also that adding DBRB increased the content of minerals such as phosphorus, potassium, iron, copper, zinc and calcium. Addition of DBRB reduced lipid profile, serum total cholesterol (TG) ,low density lipoprotein cholesterol (LDLc) and very low density lipoprotein cholesterol (vLDLc) with increasing levels of DBRB. On the other hand, the activities of liver enzymes (AST, ALT and total bilirubin mg/dl) were decreased in rats fed on fortified bread with DBRB .This study has demonstrated that DBRB can be considered as a good functional food for adding nutritional value of food products.

Keywords: Black rice bran, defatted rice bran, bread, minerals and lipid profile

INTRODUCTION

Bread and bakery products have an important role in human nutrition. Generally, wheat bread is considered to be a good source of energy and irreplaceable nutrients for the human body. This is especially true for the products made from whole grain or high-yield flour types. Bread prepared from refined flour is nutritionally much poor and does not adequately meet the requirements for many macro- or micro-nutrients (Anderson *et al*., 1998) .

Also, wheat protein lacks the balance of essential amino acids- lysine, threonine and valine. Therefore, there have been many on-going investigations on enhancing the nutritive value of bread to fulfill the expanding demands of modern dietary habits, considering the products' protein, minerals, vitamins and/or fiber contents. Bakery products, supplemented with various nutritious, protective and ballast substances, have been gaining popularity worldwide. Mixed grain, whole grain bread and related products are even considered as functional foods because they are convenient vehicles for important nutrients and phytochemicals (Skrbic and Filipc, 2008).

Rice bran powder has high protein, fiber content and bioactive compounds (Saunders, 1990) and can offers benefits with wheat flour and does not contain gluten, a like lowering of blood cholesterol (Kahlon *et al*., 1994 and Chotimarkorn and Silalai, 2007).Defatted Rice Bran (DFRB) is rich in proteins, minerals and vitamins. Possible health benefits of DFRB consumption include increased fecal bulk and reduced blood cholesterol (Abdul and Yu, 2000). The rice bran supplementation to wheat flour enhanced the contents of proteins, lysine and dietary fiber proportionately to the level of substitution. Fortification of rice bran is evident across a number of markets, having found application in bread (Hu *et al*., 2009).

Generally rice bran contains 15 % to 20 % oil (Marshall and Wadsworth, 1994). The oryzanol present in rice bran is reported to have functions similar to vitamin E in promoting growth, facilitating capillary growth in the skin. and improving blood circulation along with stimulating hormonal secretion (Luh *et al*., 1991). Rice bran has high nutritional value with 12-15% protein content (Saunders, 1990). Rice bran protein is higher in lysine content than rice endosperm protein or any other cereal bran proteins (Juliano, 1985). The protein efficiency ratio (PER) has been widely used as an indicator of protein nutritional quality. The PER values for rice bran concentrates range from 2.0 to 2.5, compared to 2.5 for casein. Protein digestibility of rice bran is greater than 90%.

Warren and Farrell (1990) reported that the crude protein (13.4 - 17.4 %), fat (20.4 - 23.4 %) and ash (10.5 %) among several cultivars of rice bran grown in Australia. Rice bran is rich source of essential nutrients like carbohydrates, proteins, fats, dietary fibers and antioxidants like tocopherols, tocotrienols, phytosterols and oryzanol. (Godber and Juliano, 2004;Orthoesfer and Eastman, 2004).The nutritional composition of rice bran confirms its potential for the development of food products. (Premakumari *et al*., 2012)

Rice bran is an excellent source of total dietary fiber ranging from 20-51% (Saunders, 1990).Rice bran fiber has laxative effect with increments of increased fecal output and stool frequencies (Tomlin and Read, 1988).

The pigment of certain rice can inhibit the formation of atherosclerotic plaque, because it has anti-oxidative or anti-inflammatory effects (Anderson, 2004).

This study was carried out to produce bread by substituting wheat flour using defatted black rice bran (DBRB) with different levels. The qualities of produced bread including physical, chemical and sensory properties were evaluated. This attempt was made to produce better and nutritious black rice products and adding value to black rice bran, which is likely to be ignored and considered as waste product.

MATERIALS AND METHODS

Materials

Black rice (*Oryza sativa L.*indica), was obtained from Rice Research and TrainingCenter (RRTC), Sakha, Kafr El-Sheikh Governorate, Egypt. Wheat flour (72%) extraction,, sugar, skimmed milk,olive oil, improver, sodium chloride and instant dry yeast were purchased from the local market in Kafr El-Sheikh Governorate, Egypt. Cholesterol powder obtained from ALgomhoria Co. for Trading in Medicines, Chemicals and Medical Supplies, Cairo, Egypt.

Animals:

Male albino rats of Sprague Dawley (90 ± 6 g) strain were obtained from the Agricultural Research Center, Giza, Egypt.

Methods

Preparation of defatted black rice bran

Black rice grains were cleaned from impurities, broken grains, dust and other foreign matters, husked by dehulling machine and sieved to separate grain from bran. Rice bran was ground passed through 80 mesh sieves (Wanyo *et al*., 2009).Rice bran were separated in two halves, the first part of black rice bran left as it is and the second part was defatted where extracted by slurring with four volumes of hexane at room temperature for 1 hour (Sharif *et al*., 2009). Five formulas were prepared which wheat flour was substituted with defatted black rice bran (5, 10, 15 and 20 %) as shown in Table (1):

Table (1): Bread formulas prepared with defatted black rice bran.

Treatments / Ingredient	Control	5% DBRB	10% DBRB	15% DBRB	20% DBRB
Wheat flour (72%)	100	95	90	85	80
DBRB (g)	-	5	10	15	20
Sugar	5	5	5	5	5
Olive oil	5	5	5	5	5
Skimmed milk	2.5	2.5	2.5	2.5	2.5
Improver	1.2	1.2	1.2	1.2	1.2
Sodium chloride	1.7	1.7	1.7	1.7	1.7
Dry yeast	1.2	1.2	1.2	1.2	1.2
Water	As required	As required	As required	As required	As required

Preparation of defatted black rice bran bread

The defatted black rice bran bread were prepared with Partially (5, 10, 15 and 20 %) DBRB flour fortified straight grade flours following the straight dough method as described in AACC (2002) method No. 10-10B. The ingredients were mixed mechanically for 5-10 minutes to form dough and allowed to ferment at 30°C and 75% R.H. for 180 minutes. First and second punches were made after 120 and 150 minutes, respectively. The dough was divided into 3 parts and final proofing was done for 45 minutes at 95 °F (35 °C) and 85% R.H. The bread was baked at 232 °C for 45 minutes, the different ingredients used in preparation bread are shown in Table (1), provided that several formulae were tested and the best one presented.

Rheological properties

The rheological properties of bread dough was determined using farinograph and extensograph according to the methods described in A.A.C.C. (1983).

Sensory evaluation of defatted black rice bread:

Twenty members' of students and staff members (both male and female) of the Home Economics Department Kafr El-Sheikh Univ, evaluated sensorally the produced bread. The panelists evaluated the samples for appearance, colour, flavour, texture and overall acceptability. Each sensory attribute was rated on a 7 point hedonic scale (1 disliked extremely, 3 neither liked nor disliked, 7 liked extremely) (Peter, 2004).

Gross chemical composition:

Moisture, ash, crude protein and ether extract contents were determined according to the methods of A.O.A.C. (2000).Crude fiber was determined according to the method reported by Kirk and Sawer, (1991).Carbohydrates were calculated by difference =100- (%protein + %fat +%ash +%fiber).

Minerals:

Mineral contents (Na, K, Fe ,Zn ,Cu and Ca) of all products were determinedusing atomic absorption (NC.9423-400-30042) England according to the methods described by A.O.A.C. (2000).

Biological assay:

Experimental animal's diet

The standard diet was formulated according to NRC (1995) and composed of the following Table (2)

Table (2) : The composition of standard diet .

Ingredients	diet g/kg
Casein	200
Corn starch	497
Sucrose	100
Vitamin mixtures	20
Mineral mixtures	100
Corn oil	50
DL- methionine	3
Cellulose	30

Experimental design:

After feeding on basal diet (Table 2) for 7 days(acclimation period)were randomly divided to 7 groups(n=7).

After acclimation, rats were fed on different diets as shown:

G1: Normal rats fed on basal diet(+ ve control).

G2: Hypercholesteremic rats fed on basal diet(- ve control).

G3: Hypercholesteremic rats fed on basal diet wit control bread.

G4:Hypercholesteremic rats fed on basal dietwith 5% DBRB bread.

G5:Hypercholesteremic rats fed onbasal diet with 10% DBRB bread.

G6:Hypercholesteremic rats fed on basal diet with 15% DBRBbread.

G7:Hypercholesteremic rats fed on basal diet with 20% DBRB bread.

Induction of cholesterol

Normal rats fed hypercholesterolemic a social diet for inducing hypercholesterolemia, the diet was prepared from fine ingredients per 100 gm according to Rashwan (1998).

Rats were weekly weighted, and food intake, body weight gain (BWG %) and food efficiency ratios (FER) were calculated at the end of the experiment according to (Chapman *et al.*, 1959) using the following formula:

BWG % = (Final Weight – Initial / Initial Weight) × 100.

FER = Gain in body (g/day)/ Food intake (g/ day)

Food Intake = Rat body weight × (10/100).

Blood samples*:*

At the end of the experiment periods, rats were anaesthetized by diethyl ether and sacrificed. Blood samples were collected in two test tubes. The whole blood in the Ethylene diamine tetra acetic acid (EDTA) tube was used for estimation of some biochemical analysis. The other tubes of blood were left for coagulation then centrifuged at 3000 rpm for 15 min to obtain serum for further analysis. All serum samples were kept at 4 C° before determination of the biochemical parameters.

Biochemical analysis:

Lipidprofile:

Lipid pattern fractions were estimated by using the spin react enzymatic kits as the following:-Serum total cholesterol (TC) was measured according to Richmond (1973). Serum triglyceride (TG) were determined by enzymatic method according to Buccolo and David (1973) . Serum high denisity lipoprotein cholesterol (HDLc) was determined according to Grodon andAmer (1977).Low density lipoprotein cholesterol (LDLc) and very low denisity lipoprotein cholesterol (vLDLc) were calculated according to Lee and Nieman (1996) as following :-

LDL-c = Total cholesterol –(HDL-c +vLDL-c)vLDL-c = TG / 5

Athrogenic index were calculated by cholesterol / HDL-c LDL-c /HDL-caccording to Castelli and Levit(1977).

Liver functions

Liver functions were determined by enzymatic method using kits which obtained from Biocan Diagnostics as following analysis. Serum alanine and aspartate aminotransferase enzymes activity (ALT and AST) were determined according to the method of Reitman and Frankel (1957).Serum total bilirubin was estimated according to Jendrassik (1938) and Timmons et al. (2003).

Renal functions:

Renal functions were determined as follows:Serum uric acid was determined according to Hennry, (1964).Serum creatinine was enzymetrically determined according to Young (2001).

Statistical Analysis:

All the obtained data were statistically analyzed by SPSS computer software by analysis of variance (ANOVA) and followedLSD test by SPSS ver.11 according to Abo-Allam (2003).

RESULTS AND DISCUSSION

Gross chemical composition of black rice and black rice bran

Proximate chemical composition of black rice and black rice bran is presented in Table (3).Dry matter content was the highest in black rice bran (91.00%) compared with black rice (88.40%). From Table (3), moisture, protein, fat and carbohydrates content in black rice bran were higher than those of black rice grain. On the other hand, ash and fiber content in black rice bran were higher compared with black rice grain, the values were 17.70, 59.65 and 3.0 1, 15.14 in bran black rice and black rice, respectively.

Table (3): Chemical composition of black rice grain and bran black rice

Sample / Constituent %	Black rice grain	Black rice Bran
Dry matter	88.40	91.00
Moisture	11.60	9.00
Protein	5.86	1.50
Fat	1.22	0.1
Ash	3.01	17.70
Fiber	15.14	59.65
Carbohydrates	74.77	25.48

These results are in agreement with those of Farrell,(1994) who reported that rice bran is a good source of dietary fiber and minerals .From these results, it could be observed that black rice bran contains high percentage of crude fiber (59.65%) and can be considered as a good source for crude fibers.

Minerals content of black rice and black rice bran

Minerals content (Mg, K ,Na, Ca, Fe and Zn mg/100g) of black rice and black rice bran are presented in Table (4) . Minerals present in rice like zinc, manganese, iron and copper play an important role in body regulatory functions ,it could be noticed that black rice bran content of minerals was higher than that of black rice grain expect in Na and Ca, black rice was the highest the values were 135.19,1894,6,50.6 and 31.07 (mg/100g) in Mg, K , Fe and Zn. Rice bran is an incredible source of the vitamins, minerals. Lloyd *et., al*(2000) reported that rice bran contained high amounts of minerals such as phosphorus, potassium, iron, copper and zinc.

Table (4) Mineral contents of black rice and black rice bran (mg /100g)

Sample	Mg	K	Na	Ca	Fe	Zn
Black rice	133.75	768.73	5171.79	412.23	15.51	30.14
Black rice bran	135.19	1894.6	2181.38	76.62	50.69	31.07

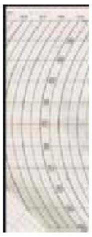
Rheological properties of bread dough treated with defatted black rice bran

The effect of adding defatted black rice bran to bread at varying levels on extensible properties is illustrated in Table (5) and Fig (1,2) .The Farinograph measures and records resistance of dough to mixing. It is used to determine the stability and other characteristics of dough during mixing. Water absorption (%) values gradually decreased by addition levels of defatted black rice bran flour (5,10,15 and 20%). The highest decrease noticed in 20% defatted black rice bran (DBRB) bread dough. This is generally lower than the baking or operational absorption (Stauffer, 1998). Similar effects on water absorption were observed by Sudha *et al*., (2007) when wheat bran or rice bran was added. Rosell et al., (2001) reported that the differences in water absorption are mainly caused by the greater number of hydroxyl groups which exist in the fiber structure and allow more water interactions through hydrogen. Arrival time ranged from 2.1in control bread to 0.50 in 5 % (DBRB). Dough development time is the time taken from the start of mixing to the point of maximum viscosity just before the curve starts to weaken. During this stage of mixing the flour water mixture is converted from a thick viscous mass to a smooth viscoelastic mass.

The dough development is related to changes occurring in gluten protein (Appolonia and Kunerth, 1994). Stability is the time difference between the point where the top of the curve first intersects the 500 BU line and the point where the top of curve leaves the 500 BU line. This gives a measure of tolerance of flour to mixing and the cohesiveness and elasticity of the dough (Appolonia andKunerth, 1994). Ranged from 12 to 11.2 (min) in control bread and 5% defatted black rice bran (DBRB) bread. Degree of weakening ranged from 30 to 20(B.U) Brabender units in 20 % bread fortified with defatted black rice bran (DBRB) and control bread. Resistance of extension was the highest in control 480(B.U)Brabender units and the lowest in 20 % bread (DBRB).Extensibility (mm) was the highest in control bread (132 mm) and the lowest (93 mm) in 20 % bread (DBRB) bread. Proportional number (P.N.) was the highest in control bread (3.68) and the lowest (1.18) in 20 % DBRB bread. Dough energy (cm^2) was the highest in control bread (99) and the lowest (19) in 20 % DBRB bread

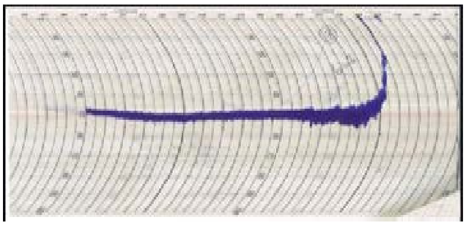
Table (5): Farinograph and Extensograph of bread fortified with defatted black rice bran:-

	Samples / Parameters	Control bread	Bread +5 % DBRB	Bread +10 % DBRB	Bread +15 % DBRB	Bread + 20 % DBRB
Farinograph	Water absorption (%)	75.9	69.9	67.2	65.75	63.05
	Arrival time (min)	2.1	0.55	0.50	1.15	1.2
	Development time (min)	3.4	1.65	1.0	1.75	1
	Stability time (min)	12	11.2	11.9	11.8	11.5
	Degree of weakening (B.U)	20	22	23	25	30
Extensograph	Resistance of extension (B.U)	480	340	245	195	110
	Extensibility (mm)	132	127	125	122	93
	Proportional number P.N	3.68	2.68	1.97	1.66	1.18
	Dough energy (cm2)	99	68	52	33	19

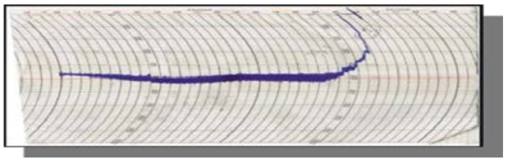


(2)) Bread+5 % (DBRB)

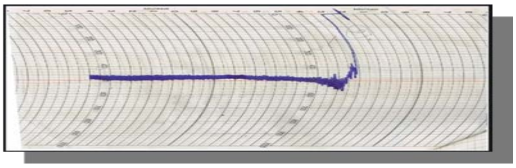
(1) Control) Bread



(4)) Bread +15% (DBRB)

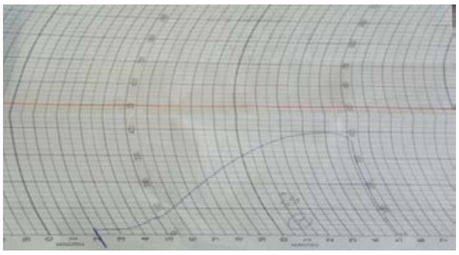


(3)) Bread+10% (DBRB)

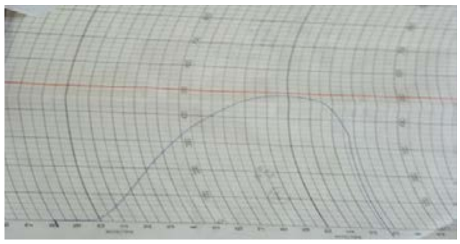


(5) Bread +20% (DBRB)

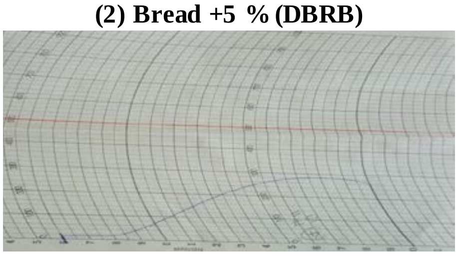
Fig(1):Farinogram of bread fortified with defatted black rice bran



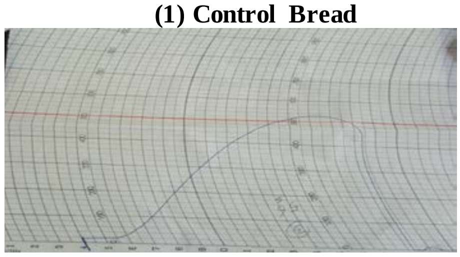
(2) Bread +5 % (DBRB)



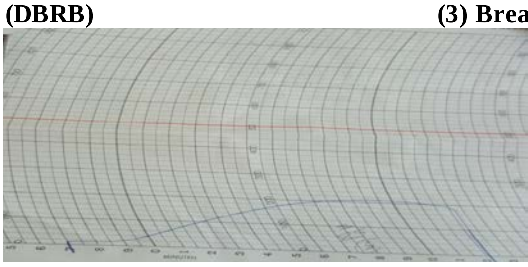
(1) Control Bread



(4) Bread +15 % (DBRB)



(3) Bread +10 % (DBRB)



5) Bread +20 % (DBRB)

Fig(2): Extensogram of bread fortified with defatted black rice bran

Sensory evaluation of bread fortified with defatted black rice bran

Data in Table (6) show the sensory evaluation of bread fortified with defatted bran of black rice including taste, odour, internal color, external color, texture, appearance and overall acceptability. The taste is a sensation perceived by the tongue and influenced by the texture. It ranged between 6.34±0.23 to 5.25±0.26 in control bread and defatted bran black rice bread, respectively. Odour ranged from7.00 ±0.0.1 to 5.22 ±0.32 in control bread and bread +15 % (DBRB).

Colour changes are might be due caramelization, dextrinisation of starch or maillard reaction involving the interaction of reducing sugar with protein. Internal color values ranged from6.81±0.21 to 6.60 ±0.74 in control bread and bread + 20 %(DBRB). External color in the fortified bread samples ranged from 6.89±0.02 in control bread to 5.12±0.04 in black rice bran bread 20%.The crust colour is attributed to the maillard reaction between reducing sugars and proteins. The reaction commences at temperatures above 150 °C. These reactions also produce the bread flavour and aroma of baking (Wiggins, 1998).

Food texture is extremely important to the consumer is used by the consumer as an indicator of food quality. It's ranged between 7.00±0.11 to 5.51±0.50 in control bread and 15% fortified bread. The texture of bread crumbs depends on its mechanical properties such as firmness or softness and resiliency. The crumb texture has attracted most attention in bread assessment because of the close association with human perception of freshness (Cauvain, 1998) . Appearance ranged from 7.00±0.34 to 5.25±0.49 in control bread and bread +20 % (DBRB), respectively .Over all acceptability ranged from 6.82±0.37 to 5.79±0.69 in control bread and 20% fortified bread. Hosney (1994) suggested that the appearance of bread was an important sensory characteristic on which the acceptability of bread depends, it could be noticed that over all acceptability decrease by more additives of bran black rice. The variation among the taste scores of bread samples occurs due to interaction between the flavour and chewing quality of bread samples. The scores were more related to the studies of (Noomhorm *et al.*, 1994), where they reported that the rice variety had influenced the taste scores of bread samples.

In general, bread prepared with addition of DBRB was acceptable, but recorded lower scores than those of control bread. These results are in agreement with these obtained by Park *et al.*, 1997; Hassan (2003) and Khalil *et al.*, (2015), who reported that adding different sources of fibers in pan bread making decreased organoleptic properties.

Proximate chemical composition of bread fortified with defatted black rice bran:

Table (7) shows the proximate composition of the bread made by addition of defatted black rice bran at differentlevels. The analysis of variance on all proximate analysis data showed significant differences between the bread samples at $p<0.05$. The moisture content values were 7.55 ±0.12 and 5.40 ±0.14 for the control bread and 20% defatted black rice bran (DBRB) bread, respectively. This result implies that, the moisture content of the samples decreased with increase in the levels of black rice bran flour. Crude protein values were 9.47±0.32and 10.97±0.69 for the control bread and20% defatted black rice bran bread (DBRB), respectively, while fat contents values were 4.91±0.33and 4.38±0.53 for control bread and defatted black rice bran bread (DBRB), respectively. This means that, the fat content significantly decreased when black rice bran flour increased. Furthermore, fiber contents values were 3.67± 0.68 and 8.58±0.28 for control bread and defatted black rice bran bread (DBRB), respectively implying a significant increase in fiber content with increasing the levels of defatted black rice bran flour .The results also show that carbohydrates content of 79.10±0.21 and 72.08±0.26 for control bread and 20% defatted black rice bran bread (DBRB), respectively which suggest significant decrease in carbohydrate contents as the defatted black rice bran flour level increased. The ash content were 2.85± 0.12and 3.99±0.75for control bread and 20% defatted black rice bran bread (DBRB), which also showed a significant increase in the ash content as the black rice bran flour levels increased. These results are confirmed with those of (Farrell, 1994 and Pomeranz and Oryl,(1982), . The present study is also in accordance with the findings of (Saunders ,1990) who illustrated that the stabilized and parboiled rice bran had moisture 12 %, protein 13 %, fat 16 %, crude fiber 9 % and ash 10 %

Minerals composition of bread fortified with defatted black rice bran :

Table (8) shows the minerals composition of the defatted black rice bran -wheat composite bread samples. Calcium content in the examined samples ranged from (105.21 to 69.80mg/100gm) in control bread and 20% defatted black rice bran(DBRB), respectively. Potassium values was the highest (198.4mg/100gm)in 20% defatted black rice bran (DBRB), and the lowest (103.95mg/100gm) incontrol bread(Lloyd et al., 2000). Magnesium ranged from 90.69 to 73.86 mg/100gm in 20% defatted black rice bran (DBRB) and control bread. Sodium values ranged from 467.47 to 269.75 mg/100gm in 20% defatted black rice bran (DBRB) and control bread. Zinc plays a central role in the immune system, affecting a number of aspects of cellular and humeral immunity. Values of zinc recorded 3.33 and 1.03, the highest values were in 20% defatted black rice bran (DBRB) and the lowest was in control bread. Phosphor values was 339.38 to 193.25in 20% defatted black rice bran (DBRB) and control bread. Iron values ranged from 4.67 to 2.12mg/100gm in 20% defatted black rice bran (DBRB) and control bread. Generally, adding defatted black rice bran (DBRB) increased the minerals contents of the produced bread. These results are in accordance with those of Thompson *et al.(*2005) Sharif *et al.*,(2009) and Makinde and Akinoso,(2014)

Table (6): Sensory evaluation of bread fortified with defattedblack rice bran

Samples / Constituent %	Control bread	Bread +5 % (DBRB)	Bread +10 % (DBRB)	Bread +15 % (DBRB)	Bread +20 % (DBRB)
Taste	6.34±0.23	6.17±0.17	5.50±0.17	5.35±0.23	5.25±0.26
Odour	7.00±0.01	6.62±0.32	6.16±0.39	5.22±0.32	5.29±0.47
Internal color	6.81±0.21	6.44±0.32	6.56±0.31	6.62±0.74	5.60±0.80
External color	6.89±0.02	6.06±0.02	6.60±0.045	5.50±0.08	5.12±0.04
Texture	7.00±0.11	6.21±0.21	6.30±0.45	5.51±0.50	5.66±0.45
Appearance	7.00±0.34	5.41±0.74	6.60±0.54	5.80±0.67	5.25±0.49
Over all acceptability	6.82±0.37	6.45±0.5	6.10±0.78	6.11±0.37	5.79±0.69

Each value is the mean ± SD
Mean values in each column are significantly different at p <0.05.

Table (7) Proximate chemical composition of bread fortified with defatted black rice bran

Samples / Constituent %	Control bread	Bread +5 % (DBRB)	Bread +10 % (DBRB)	Bread +15 % (DBRB)	Bread +20 % (DBRB)
Moisture	7.55 ±0.12	7.23 ±0.61	5.85 ±0.37	6.72 ± 0.39	5.40 ±0.14
Protein	9.47±0.32	10.12±0.81	10.36±0.71	10.65±0.99	10.97±0.69
Fat	4.91±0.33	4.87± 0.28	4.63±0.43	4.46±0.47	4.38±0.53
Ash	2.85± 0.12	3.95±0.25	3.63±0.44	3.33±0.67	3.99±0.75
Fiber	3.67± 0.68	5.44±0.49	6.42±0.52	7.60±0.43	8.58±0.28
Carbohydrates	79.10±0.21	75.61±0.35	74.96±0.43	73.96±0.38	72.08±0.26

Each value is the mean SD
Mean values in each column are significantly different at p <0.05.

Table (8): Minerals composition of bread fortified with defatted black rice bran

Samples / Minerals mg/100g	Control bread	Bread +5 % (DBRB)	Bread +10 % (DBRB)	Bread +15 % (DBRB)	Bread +20 % (DBRB)
Ca	69.80	87.28	97.47	102.67	105.21
K	103.95	112.86	140.31	143.87	198.4
Mg	73.86	77.93	85.24	89.34	90.69
Na	269.75	328.26	413.63	423.2	467.47
Zn	1.03	1.43	1.67	2.87	3.33
P	193.25	235.56	273.17	306.77	339.38
Fe	2.12	2.88	4.31	4.56	4.67

Biological assay

Feeding and growth parameters of rats fed on bread fortified with defatted black rice bran

Table (9) shows feeding growth parameters of rats fed on bread fortified with defatted black rice bran compared with control bread. From these results, it could be observed the variance between food intake according to the type of fed bread. The highest intake (18.039) was noticed in group fed on bread with 20% DBRB (G7), while the lowest food intake was in rats of G4. Concerning food efficiency ratio (FER), there were significance differences between both control group and cholesterolemic rats. Also, rats of G7 showed the highest FER.

The maximum weight gain (87.139 g) was observed in rats fed on 20% DBRB bread. These results confirmed that the addition of DBRB the bread improved the nutritive value of bread. This is due to the presence of bioactive compounds in DBRB. These finding in accordance with these obtained by many researchers (Lotfy 2015 and Khalil 2015). Lipid profile

Data in Table (10) show that the highest value of cholesterol (157.96 mg/dl) was observed in rats in G2 fed on basal diet. Feeding on bread containing DBRB decreased TC. Lowering of cholesterol may be attributed to the high content of fiber in DBRB. These results are in accordance with those of Khalil*et al.*, (2015). The major components of orzaynol present in DBRB help in lowering plasma cholesterol. It has also been used to cause hyper lipidemia(Kehlon *et. a.l.*, 1994).

From the same table, the highest triglycarides value (127.08 mg/dl) was observed in rats (G2) fed on basel diet. Treatment with bread containing DBRB showed an effect on TG content. The highest effect was noticed in rats fed on 5% DBRB bread (77.7 mg/dl) all treatments with different level DBRB caused noticeable decreased in TC, LDLc and vLDLc values, while resulted in an increase HLDc values. This may be attributed its presence of several bioactive compounds rice bran which possess significant antioxidant activity. These results are confirmed with those of (Zawistowski*et al.*, 2009;Ayano*et al.*, 2008)

Table (10): Feed and growth parameters of rats fed on bread fortified with defatted black rice bran

Rats groups / Parameters	G1-Control (+ve)	G2-Control (-ve)	G3-Control bread	G4- Bread +5 % (DBRB)	G5-Bread +10 % (DBRB)	G6-Bread +15 % (DBRB)	G7-Bread +20 % (DBRB)
Initial weight	91.10± 0.23	93.13± 0.15	91.24± 0.14	90.06± 0.23	94.33± 0.37	89.81± 0.46	92.02± 0.36
Final weight	157.21± 0.21	98.15± 0.22	146.62± 0.24	149.47± 0.48	163.54± 0.43	170.48± 0.32	179.15± 0.38
Weight gain	66.11± 0.25	5.02± 0.35	55.38± 0.38	59.41± 0.39	69.21± 0.51	67.00± 0.69	87.13± 0.68
Food intake	17.56± 0.20	16.69± 0.12	17.39 ± 0.19	16.56± 0.26	17.71± 0.37	17.16± 0.32	18.03± 0.36
Food efficiency ratio (FER)	3.76± 0.10	0.30± 0.12	3.18± 0.11	3.59± 0.13	3.91± 0.17	4.3± 0.12	4.83± 0.15

Each value is the mean SD
Mean values in each column are significantly different at p <0.05
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Kidney and Liver functions:

From results in Table (11), it could be noticed that urea and creatinine values (83 and 1.11 mg/dl, respectively) urea the highest in hyperchrolestermic rats (0.2) and decreased by feeding on bread treated with DBRB. This means that DBRB caused lowering in kidney functions.

Hepatic dysfunction such as elevation of transaminases is associated with hyperchrolestermic. So, liver transaminases (AST or SGOT and ALT or SGPT) are useful biomarkers of liver injury. Data in Table (11) show that effect of DBRB addition to the bread in induced hyperchrolestermic rats on liver functions measured by levels of SGPT and SGOT enzymes. Results in table (11) show that SGPT , SGOT(U/L) and total Bilirubin levels was the highest in Hypercholesteremic rats Control (ve-) and the lowest in 20% defatted black rice bran bread (DBRB)

These results suggest that black rice consider is a healthful food that may be useful in the reducing the risks of hepatic osteoporosis and its related disorders such as hyperlipidemia and hyperglycemia, these results an accordance with those of(Halliwell and Gutteridge, 2001; Galati and O'Brien, 2004).

Table (11): Serum lipid profile of rats fed on bread fortified with defatted black rice bran

Rats groups / Parameters	Control (ve+)	Control (ve-)	Control bread	Bread +5 % (DBRB)	Bread +10 % (DBRB)	Bread +15 % (DBRB)	Bread +20 % (DBRB)
T. C (mg/dl)	88.42± 0.21	157.96± 0.32	97.14 ± 0.25	74.75± 0.43	77.9± 0.48	81.91± 0.33	85.75± 0.56
Tri G (mg/dl)	82.17± 0.38	127.08± 0.36	105.20 ± 0.17	77.7± 0.43	80.55± 0.32	84.27± 0.43	89.45± 0.46
HDLc (mg/dl)	46.23± 0.28	25.37± 0.74	29.13 ± 0.58	35.10± 0.59	39.44± 0.91	44.32± 0.28	62.24± 0.77
LDLc(mg/dl)	25.76± 0.32	107.18± 0.34	46.97± 0.31	24.11± 0.26	22.35± 0.29	20.69± 0.38	5.62± 0.35
VLDLc (mg/dl)	16.43± 0.12	25.41± 0.24	21.04± 0.38	15.53± 0.42	16.10± 0.44	16.62± 0.56	17.88± 0.64

Table (11) Kidney and Liver function of rats fed on bread fortified with defatted black rice bran:

Rats groups / Parameters	Control (+ve)	Control (-ve)	Control bread	Bread +5 % (DBRB)	Bread +10 % (DBRB)	Bread +15 % (DBRB)	Bread +20 % (DBRB)
Urea (mg/dl)	26± 0.23	83± 0.21	37± 0.15	38± 0.14	33± 0.10	30± 0.20	29± 0.11
Creatinine (mg/dl)	0.71± 0.11	1.11± 0.1	0.92± 0.23	0.90± 0.52	0.87± 0.30	0.78± 0.42	0.75± 0.16
SGPT(U/L)	47± 0.21	66± 0.85	40± 0.75	33± 0.56	36± 0.64	37± 0.67	31± 0.26
SGOT(U/L)	177± 0.31	274± 0.61	165± 0.24	133± 0.85	137± 0.76	130± 0.34	99± 0.16
Total Bilirubin (mg/dl)	0.35± 0.43	0.46± 0.61	0.38± 0.42	0.27± 0.17	0.24± 0.14	0.22± 0.55	0.19± 0.13

Each value is the mean SD
Mean values in each column are significantly different at p <0.05.

REFERENCES

A.O.A.C. (2000). Official Methods of Analysis of the Association of Official Analytical Chemists 15th edition, Virginia, U.S.A.

AACC. (1984). Approved methods of analysis. St. Paul, Minnesota. The American Association of Cereal Chemists.

Abdul, H.A. and S.L. Yu (2000). Functional properties of dietary fiber prepared from defatted rice bran. Food Chem., 68: 15-19.

Abo-Allam, R. M (2003).Data Statistical Analysis Using SPSS Program. 1st ed., Publication for Universities, Cairo

Anderson, J. W. and Pasupuleti, V. (2008).Future trends and directions.In Nutraceuticals, Glycemic Health and Diabetes, ed. V Pasupuleti, JW Anderson. Ames, IA: Blackwell, USA.

Andersson, R., Hama ,L.A.and Aman, P. (1998). Predictive modelling of the bread-making performance and dough properties of wheat . J. of Cereal Science 20 (2), 129–138.

Appolonia, B.L.D and Kunerth, W.H. (1994).The Farinograph Handbook (3rd edition), American Association of Cereal Chemists, St Paul, USA.

Ayano, Y., OHTA, F., WATANABE, Y., and MITA, K. (1980). Dietary fiber fractions in defatted rice bran and their hypocholesterolemic effect in cholesterol-fed rats. J. Nutr. Food (Japanese) 33:283.

Buccolo,G. and David,H. (1973). Ouantitative determinarion of serum triglyceride by use enzymes.Clin. Chem.,19: 419-32.

Castelli ,T. and Levitar, Y. (1977). Atherogenic ,indexCurrPresc p39.

Cauvain, C. P. (1998). Bread the product. In: C.P. Cauvain and L.S. Young (Ed). pp. 1-17. Technology of bread making, Campden and Chorleywood Food Research Association, Gloucestershire, U.K.

Chapman, D. G.; R. Castilla and J.A. Cambell (1959).Evaluation of protein in food.I.A. Method for determination of protein efficiency ratio. Can. J .Biochem physiol., 37:679-686.

Chotimarkorn, C. and Silalai (2007).Oxidative stability of fried dough from rice flour containing rice bran powder during storage. LWT, 41: 561-568.

Farrell ,D. J. (1994).“Utilization of Rice Bran in Diets for Do- mestic Fowls and Ducklings, . J.of World’s Poultry Science, Vol. 50, No. 2, , pp. 115-131.

Galati G and O’Brien PJ .(2004). Potential toxicity of flavonoids and other dietary phenolics: significance for their chemopreventive and anticancer properties. Free Radic. Biol. Med. 37: 287-303.

Godber, J.S. and B.O. Juliano (2004).Rice lipids. In E.T. Champagne (Ed.), Rice: Chemistry and technology (3rd ed., pp: 163-190). Minnesota: American Association of Cereal Chemists Inc.

Grodon,T. and Amer,M. (1977) . Determination of HDL. J. Med.,62:707.

Halliwell B and Gutteridge JMC (2001).Free Radicals in Biology and Medicine. Oxford Science Publication, Thomson Press Ltd., India

Hassan, A.A .(2003). The role of high fiber bread on the reduction of cholesterol, triglycerides, live enzymes and histopathological alteration of experimental hyper cholesterolemic rats. Annals of Agric. Sci., Monshtohor, 41: 1297-1333

Henry , R . J .(1964). Clinical Chemistry , Harper and Row publishers ,New York ,p.181

Hosney, R.C. (1994). Principles of Cereal Science and Technology.AACC, St Paul, USA.

Hu, G., S. Huang, S. Cao and Z. Ma (2009).Effect of enrichment with hemicelluloses from rice bran on chemical and functional properties of bread. Food Chem., 115: 839-842.

Jendrassik, L. (1938). Colorimetric determination of bilirubin.Biochem., 97:72-81.

Juliano, B. O. (1985). Rice bran. In Rice: Chemistry and Technology; American Association of Cereal Chemists: St. Paul, MN.

Kehlon, T.S., F.I. Chow and R.N. Sayre (1994).Cholesterol lowering properties of rice bran. CFW, 39: 99-103.

Khalil, Mona M., Abou Raya, M. A., Ghoniem, Gehan, A. and Hussain, T.S. (2015). Effect of feeding at different levels of wheat bran and date seeds powder on diabetic rats .Journal foods and dairy Sci., Mansoura univ. 6: 435-449.

Kirk, R.S. and Sawer, R. (1991).Pearson's Composition and Analysis of Food. 9th Ed Longman .Scientific and Technical, Inc, New York: 469-529

Lamiaa, M.Lotfy. (2015). Quality attributes of toast bread using blackrice flour. J. of Food and Dairy Sci., Mansours Univ., Vol. 6 (2):41-58.

Lee,R. and Nieman,D. (1996) . Nutritional Assessment.2nd Ed. Mosby, Missouri, USA.

Lloyd BJ, Siebenmorgen TJ and Beers KW.(2000). Effect of commercial processing on anti-oxidants in rice bran. Cereal Chem. 77(5):551-555.

Luh, B. S.; S. Barber and C. Benedito de Barber (1991). Rice bran: chemistry and technology, rice production and utilization. In: Luh, B. S. (ed.). New York: Van Nostrand Reinhold.pp.313.

Makinde, F. M. and Akinoso.(2014): Physical nutritional and sensory qualities of bread samples made with wheat and black sesame (Seasamumindicum Linn) flours. International Food Research J. 21(4):1635-1640.

Marshall, W. E. and J. I. Wadsworth (1994).Rice science and technology. New York: Marcel Dekker, Inc.

Noomhorm, A. Bandola, D.C. and Kongseree, N. (1994).Effect of rice variety, rice flour concentration and enzyme levels on composite bread quality. J. Sci. Food & Agri. 64: 433-440

NRC (1995).Nationnal Research Council: Nutrient Requirement of Laboratory Fourth Reviser Edition pp 29-30 National Academy Press Washington , animals , D.C.

Orthoesfer, F.T. and J. Eastman (2004).Rice bran and oil. In E.T. Champagne (Ed.), Rice: Chemistry and technology, (3rd ed., pp: 569-593). Minnesota: American Association of Cereal Chemists Inc.

Park,H., Seibe, P.A. and Chung, O.K (1997). Fortifying bread with wheat fiber and psyllium husk fiberr plus three antioxidants.Cereal hem. 74(3): 207-211.

Peter, I. A.(2004) .Protein contents, physical and sensory properties of Nigerian snack foods (cake, chin-chin and puff-puff) prepared from cowpea – wheat flour blends .International. J. of Food Science and Technology 2004, 39, 419–424

Pomeranz, Y. and R.L. Oryl. (1982). Rice processing and utilization. CRC Handbook of Processing and Utilization in Agriculture, Vol. II.CRC Press, West Palm Beach, FL.

Premakumari S, Balasasirekha R, Gomathi K, Supriya S, Jagan Mohan R and Alagusundram K, (2012). Development and Acceptability of Fibre Enriched Ready Mixes, Int. J. Pure Appl. Sci. Technol., 9 74-83.

Rashwan, A. A. (1998). Effects of dietary addition of anise fenugreek and caraway on reproductive and productive performance of NewZealand White rabbit does. Egyptian Journal of Rabbit – Science. 8:2, 157-167.

Reitman,S .and Frankel, S. (1957) . Enzymatic determination of liver function.Am . J .clin .path , 28-56.

Richmond ,W. (1973). Enzymatic determination of cholesterol.Clin .chem .19,1350-1356.

Rosell CM, Marco C, García-Alvárez J, Salazar J.(2010). Rheological properties of rice–soybean protein composite flours assessed by Mixolab and ultrasound. J Food Process Eng. DOI: 10.1111/j.1745-4530.2009.00501.x.

Saunders, R. M. (1990). The properties of rice bran as a food stuff. Cereal Foods World, 35: 632-662.

Saunders, R.M.(1990). The properties of rice bran as a food stuff. Cereal Foods World., 35: 632-639.

Sharif, M. K.; M. S. Butt; F. M. Anjum and H. Nawaz (2009). Preparation of fiber and mineral enriched defatted rice bran supplemented cookies. Pakistan J. of nutrition, 8 (5): 571-577, (ISSN 1680-5194).

Skrbic ,B and Filipce.,B (2008). Nutritional and sensory evaluation of wheat breads supplemented with oleic-rich sunflower seed. Food Chem. 108: 119–129.

Stauffer, C.E. (1998). Principles of dough formation. pp. 262-295. In: Cauvain, C.P. and Young, L.S. (Ed.). Technology of Bread Making, Campden and Chorleywood Food Res. Asso., Gloucestershire, U.K.

stitution pf wheat flour with rice flour and rice bran in flake products: Effects on chemical, physical and antioxidant properties. J. W0rld Applied Sciences. 7 (1): 49-56, (ISSN 1818-4952).

Thompson, T; M. Dennis and L. A. Higgins (2005). Gluten-free diet survey:are Americans: with celiac disease consuming recommended amounts fiber, iron, calcium and grain foods? J Hum Nut., Diet, 18: 163-169.

Timmons, D. L.; Hall, P. E. and Johnson C. W. (2003). Essential laboratory mathematics: concepts and applications for the chemical and clinical laboratory technician. THOMSON, Delmar Learning, 2ed, Canada, p 137-166.

Tomlin ,j and N,W,Read ,(1988). Comparision of the effects on colonic function caused by feeding rice bran and wheat bran .j.clin Nutr.42: 857.

Wanyo, P.; C. Chomnawng.and S. Siriamornpun (2009). Sub

Warren, B.E. and D.J. Farrell. (1990). The nutritive value of full fat and defatted Australian rice bran and chemica composition. Anim. Feed Sci. Tech. 27:219-223

Wiggins, C. (1998). Proving, baking and cooking. In: Cauvain, C.P. and Young, L.S. (Ed.). Technology of Bread Making, Campden and Chorleywood Food Res. Asso., Gloucestershire, U.K.

Young, J. (2001). Functional bakery products: current directions and future opportunities. Food Industry Journal 4, 136e144.

Zawistowski J., Kope A., D. Kitts. (2009).Effects of a black rice extract (Oryza sativa L. indica) on cholesterol levels and plasma lipid parameters in Wistar Kyoto rats.J. of Functional Foods.Vol. 1, Issue 1, Pages 50–56

الاستفادة من نخالة الأرز الأسود المنزوعة الدهن في إنتاج خبز القمح لتعزيز الخصائص الغذائية والوظيفية

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أجريت هذه الدراسة، لإنتاج خبز مدعم بنخالة الأرز الأسود المنزوعة الدهن وذلك من خلال إعداد خلطات من الدقيق الأبيض و نخالة الأرز الأسود منزوع الدهن بنسب مختلفة هي ٥،١٠،١٥،٢٠% . تم تقييم خصائص جودة الخبز وتشمل الخصائص الريولوجية ،الصفات الحسيه ،التركيب الكيماوي والعناصر المعدنية،أيضا تم قياس التأثيرات البيولوجية. أشارت النتائج الي قبول الخبز حسيا المدعم بنخالة الأرز الأسود المنزوعة الدهن خاصة المحتوي علي نسبة ١٠,٥ % من نخالة الأرز الأسود المنزوعة الدهن .وقد لوحظ ارتفاع نسبه الألياف والرماد وكذلك البروتين ,بينما انخفض محتوى الرطوبة والدهن والكربوهيدرات بزيادة إضافة نخالة الأرز الأسود منزوعة الدهن. أيضا وضحت النتائج انه بإضافة نخالة الأرز الأسود المنزوعة الدهن زاد محتوي العناصر المعدنية من الفوسفور ،البوتاسيوم ،الحديد ،النحاس ،الزنك والكالسيوم .بإضافة نخالة الأرز الأسود المنزوعة الدهن لوحظ انخفاض مستوي الدهون ونسب الكولسترول الكلي والكولسترول المنخفض الكثافة والدهون الثلاثية بزيادة نسبة نخالة الأرز الأسود المنزوعة الدهن.من ناحية أخرى انخفض نشاط أنزيمات الكبد والبلو وبين الكلي في الفئران التي غذيت علي الخبز المدعم بنخالة الأرز الأسود المنزوعة الدهن .
قد أثبتت نتائج هذه الدراسة أن نخالة الارز الأسود المنزوعة الدهن يمكن اعتبارها غذاء وظيفيا جيدا لاضافة قيمة غذائية للمنتجات الغذائية