J. Food and Dairy Sci., Mansoura Univ., Vol. 6 (2):41 -58, 2015

QUALITY ATTRIBUTES OF TOAST BREAD USING BLACK RICE FLOUR

Lamiaa, M. Lotfy
Home Economic Departement, Faculty of Specific Education, KafrEl-Sheikh University, Egypt
lilytofy@yahoo.com

ABSTRACT

In this study wheat flour (WF) was substituted with completed black rice flour (CBRG) and peeled black rice grains (PBRG) with ratio 5, 10, 15 and 20 %. As results, 8 formulas were used to make 8 diets of toast determined the sensory, rheological properties, chemical composition, minerals content were determined. The biological effect on lipid and hematological profile on hypercholesterolemic rats was assayed.

Toast with 15% CBRG was the highest sensory scores in taste, internal colour and over all acceptability scores as (4.41, 4.55 and 4.18), respectively, and was not significantly different ($p<0.05$) comparing with control toast. The results showed that toast with 20% CBRG contained significantly high content in protein as (11.06). Toast with 20% PBRG had high ash content as (3.22) while, toast with 10% PBRG had high crude fibers content as (5.82).

Farinograph parameter revealed that water absorption of dough decreased to (60.80%) in dough with 10% PBRG. Dough with 10% CBRG was the highest arrival time and development time values as (3.00, 4.00 min), respectively. Dough stability values were found to be high in all toast doughs except for dough with 20% CBRG (12.00 min). Dough with 20% CBRG was the lowest dough weakening value as (10.00 min). Substitution of wheat flour by PBRG induced an increase in resistance to extension to (520 B.U.). Dough with 20% PBRG (85 mm) was the lowest extensibility value (85 mm). The highest proportional number (5.53 P.N.) was found to be in dough with 20% PBRG with being dough with 20% CBRG the lowest energy (47 cm^2).

Concerning Protein efficiency ratio (FER), rats fed on toast with 20% CBRG was the highest FER at all rat groups (5.05) and protein intake value was not differing significantly between rats group fed on toast with 15, 10% CBRG, 15% PBRG, 20% CBRG and negative control (-). Greater values of HDL-C were observed in rats fed on 20% CBRG (53.48 mg/dl). Positive control (+) group was the highest TC, TG, LDL-C and VLDL-C as 161.03, 125.17, 109.52 and 25.03 mg/dl, respectively, that's indicated to feeding rats on toast with CBRG and PBRG was significantly ($p<0.05$) improved lipid parameters as compared with positive control group.

Feeding rats on toast with 20% CBRG introduced the highest Hb value as (14.80 g/dl) as feeding rats on toast with 10% PBRG recorded a marked hematological effect on WBCs count as 4.90 comparing with 3.42 in rats fed on toast with 10% CBRG. This study has demonstrated that addition of completed black rice grains CBRG and peeled black rice grains PBRG were considered as a good functional ingredient for adding value of food product, more important, may contribute to health benefits where lipid and hematological parameters were significantly ($p<0.05$) improved in rats fed on toast with ratios of CBRG and PBRG.

INTRODUCTION

Rice is one of the leading food crops of the world, the staple food of half of the world's population. Black rice has a number of nutritional advantages over common rice, such as a higher content of protein, vitamins and minerals, although the latter varies with cultivar and production location (Suzuki *et al.,* 2004). Black rice (*Oryza sativa L.*indica), a special cultivar of rice which contain high content of anthocyanins in the aleurone layer than white rice, has been regarded as a food and widely consumed as a health-promoting foods in china and other eastern Asia countries for thousands of years (Wang *et al.,* 2007).

Whole grain products, because of their physical form and high content of fibers, tend to be slowly digested, absorbed and, thus, have relatively low glycemic indices (Liu *et al.,* 1999). Rice bran powder has high protein, fiber and bioactive compounds (Saunders, 1990), which Offer benefits with wheat flour and does not contain gluten, a like lowering of blood cholesterol (Kahlon *et al.,* 1994 and Chotimarkorn and Silalai 2007). Rice bran has high nutritional value with 12-15% protein content (Saunders, 1990). Rice bran protein contains higher lysine content than rice endosperm protein or any other cereal bran proteins (Juliano, 1985).

The objective of this study was to produce toast bread by substituting the wheat flour by completed black rice grain (CBRG) and peeled black rice grain (PBRG) flours. The qualities of produced bread including physical, chemical, sensory and rheological properties were evaluated.

MATERIALS AND METHODS

Materials:

Black rice (*Oryza sativa L*. indica), was obtained from Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh governorate, Egypt.

Animals:

Forty four white male albino rats (Sprague Dawely), weighting (89-95gm), two month old, were employed in this study. Rats were obtained from experimental animal house of Food Technology Research Institute, Agric. Res. Center, Giza, Egypt.

Methods:

All seeds were cleaned from impurities, broken seeds, dust and other foreign matters. After cleaning, black rice seeds were separated in two parts. The first part was leaved completed and grounded as a whole grain and the second part was husked by dehulling machine at Agricalture Research Center, Sakha, Kafr El-Sheikh and grounded as peeled black rice grains.

Drying process:

(CBRG) and (PBRG) were dried in oven air (60-70 ˚C) for 48 hours to dry (Sidkey *et al.,* 1993) and then all materials were ground in an electric mill and sieved at 120 mesh to produce a fine powder. All samples were kept in polyethylene bags at 5 ˚C until analysis.

Preparation of black rice formulas

Eight formulas for cholesterolmic diets were prepared using black rice seeds (completed and peeled grains) as shown in Table (A). Wheat flour was substituted with these formulas with ratio 5, 10, 15 and 20 %.

Table (A): Toast bread formulas prepared from black rice grains

Treatments	Wheat Flour (%) (WF)	Completed black rice grains (%) (CBRG) flour	Peeled black rice (%) (PBRG) flour
T1	100	0	0
T2	95	5	0
T3	95	0	5
T4	90	10	0
T5	90	0	10
T6	85	15	0
T7	85	0	15
T8	80	20	0
T9	80	0	20

T1 = (100% commercial straight grade flour) acts as control.
T2= Toast with 5% CBRG flour **T6 = Toast with 15% CBRG flour**
T3 = Toast with 5% PBRG flour **T7 = Toast with 15% PBRG flour**
T4 = Toast with 10% CBRG flour **T8 = Toast with 20% CBRG flour**
T5 = Toast with 10% PBRG flour **T9 = Toast with 20% PBRG flour**

Preparation of toast bread:

Toast breads were prepared with some modifications, Table (B) shows the ingredients of toast bread (Rabie, 2009).

Table (B): Materials used for preparation control toast

Ingredients	Gm
Flour	100
Sugar	5
Yeast	1.4
Salt	1.65
Skimmed milk	2.5
Corn oil	5
Bread improver	1.2
Water	As needed

Sensory evaluation of black rice toast bread

Eight formulas were formed as toast breads. They were sensory evaluated by test panel according to (El-Nemer, 1976). Twenty members were requested to evaluate the formulated toast bread. The test performed under fluorescent lighting in nutrition laboratory, Home Economics Department, Faculty of Specific Education, Kafr El-Sheikh University. The judges were asked to score all organoleptic qualifies in numerical system for the samples comparing with control bread.

The examined characteristics were odour, taste, interior colour, exterior colour, texture, appearance and over all acceptability. The panelists were provided with clean tap water to rinse their mouth after tasting each sample. Samples were evaluated using a 7- point hedonic scale (1 = dislike very much to 7 = like very much) (Eneche, 1999). The highest sensory evaluated toasts were selected and then they were chemically analyzed.

Rheological properties of black rice toast bread

The rheological properties of wheat flours (72%extraction) were determined using farinograph, extensograph and amylograph according to the methods described in (AACC, 1983).

Farinograph test of black rice toast bread

Farinoograph test was carried out to determine the water absorption, arrival time, stability time, dough development time, dough weakening of wheat flour according to the methods described in (AACC, 1983), as the following procedures.

Extensograph test of black rice toast bread

Extensor test was carried out on wheat flour (72% extraction) to determine the maximum resistance to extension, elasticity, proportional number and energy according to the methods described in the (AACC, 1983).

Proximate chemical composition of black rice toast bread

Moisture, fat, ash and total nitrogen contents were determined according to the methods described in AOAC (2000). The crude fibers content were determined following the method given by Pearson (1971). Total carbohydrates content were calculated by difference as follows:

% soluble carbohydrates = 100 – (% crude protein + % crude fat + % crude fibers + % total ash) on dry weight (James, 1995).

Minerals content of black rice toast bread

Minerals were estimated by wet ashing method according to AOAC (2000). Iron, calcium, potassium, sodium, magnesium and zinc were determined by using flame emission spectrometry (flame photometer) according to the method described by Pearson (1991).

Biological assay

Basal diet

Rat groups fed a basal diet consist of 10% corn oil, 10% sucrose, 4% salt mixture, 1% vitamin mixture, 0.2% choline chloride and 1.5% cholesterol powder were obtained from Morgan Co. Cairo, Egypt, neutral casein 16.28 gm (protein content 12%) and corn starch up to 100 gm (Campbell, 1963).

Experimental design

Upon arrival, they were randomly assigned to 11 groups four rats each. Each animal was individually housed in a wire bottomed, stainless steel cage under the normal condition. The animals were weighted every week except during the first week, which weighted every day. The experimental animals fed on basal diet for one week to acclimate them to our facility and basal diet. After acclimation, rats were fed on different diets as shown:

G1: Fed on basal diet (Negative control).

G2: Hypercholesteremic rats Fed on basal diet (Posative control).

G3: Hypercholesteremic rats fed on control Toast bread.

G4: Hypercholesteremic rats fed on Toast with 5% CBRG mixed with basal diet.

G5: Hypercholesteremic rats fed on Toast with 5% PBRG mixed with basal diet.

G6: Hypercholesteremic rats fed on Toast with 10% CBRG mixed with basal diet.

G7: Hypercholesteremic rats fed on Toast with 10% PBRG mixed with basal diet.

G8: Hypercholesteremic rats fed on Toast with 15% CBRG mixed with basal diet.

G9: Hypercholesteremic rats fed on Toast with 15% PBRG mixed with basal diet.

G10: Hypercholesteremic rats fed on Toast with 20% CBRG mixed with basal diet.

G11:Hypercholesteremic rats fed on Toast with 20% PBRG mixed with basal diet.

Induction of cholesterol

Normal rats fed 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 sampling

In all mentioned groups, blood samples were taken from rats at the end of study, the blood samples were collected after 12 hours fasting. At the end of experiment, rats weighed and scarified with a knife, blood of rats put into dry clean centrifuge tubes and left to colt.

The blood was centrifuged at 3500 rpm for 10 minutes to separate the serum, which was carefully aspirated and transferred into clean quite plastic tubes and kept frozen at -18 º C until biochemical analysis (El-Khamissy, 2005).

Biochemicals analysis of serum

The concentration of total cholesterol, high density lipoprotein cholesterol (HDL-c) and triglycerides in the serum were determined without extraction using enzymatic colorimetric methods with commercially available kits 276-64909 ,high density lipoprotein kits 278-67409 and triglycerides, kits274-69807; wake chemical, Osaka, Japan. (Kim and Shin 1998), procedures were employed to perform the previous mentioned determinations.

Low density lipoprotein cholesterol (LDL-c) concentration was calculated as the difference between total cholesterol and (HDL-c) according to the method of Skottova *et al*., (1998).

LDL and vLDL-c were carried out by the following equations:

vLDL-c (mg/ld) = (triglyceride / 5).

LDL-c (mg/ld) = Total cholesterol– (vLDL-c + HDL-c) **(Lopz-virella 1977).**

Hematological Parameters

Hemoglobin concentration, hematocrit level, RBCs and WBCs count were determined using animal blood counter hematology analyzer for the in vitro diagnostic testing of whole blood specimens, the Roche Diagnostic system, ABX Hematology, COBAS Microso OT Automated Hematology Analyzer, RAE 013A Instrument (Richmond, 1973).

Statistical analysis

Results are expressed as the mean ± Standard deviation. Data were statistically analyzed for variance using one way analysis of variance (ANOVA), followed by Duncan's multiple range tests according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Sensory evaluation of black rice toast bread

Sensory evaluation is usually performed towards the end of the product development or formulation cycle and is carried out to assess the reaction of judges towards the product and they rate the liking on a scale (Sharif *et al*., 2009). Consumers are readily able to assess three major food attributes, namely texture, flavor, and appearance according to Lund, (1982). Even though flavor is frequently judged as the most important food characteristic (Schutz and Wahl, 1981 and Moskowitz and Krieger, 1995), texture plays a very important role in food identification (Murphy, 1985).

Table (1) shows sensory score for taste, odour, internal and external colour, texture, appearance and overall acceptability. There were found to be significantly different compared with control. The scores for all characteristic tests of rice toast bread were all at acceptable values.

Table (1): Sensory evaluation of toast bread made from CBRG and PBRG flour.

Toast bread samples		Sensory evaluation of black rice toast bread						
		Taste	Odour	Internal colour	External colour	Texture	Apperance	Over all acceptability
1	Control toast	3.33 d ± 1.09	3.83 b ± 1.23	3.83 b ± 0.98	4.33 ab ± 1.42	4.25 ab ± 0.77	4.42 a ± 1.13	23.99 c ± 2.15
2	Toast with 5% CBRG	4.12 b ± 0.82	3.49 c ± 2.15	4.03 b ± 1.07	4.51 a ±1.34	4.11 ab ±2.09	3.93 ab ±1.50	24.19 b ± 1.03
3	Toast with 5% PBRG	4.01 b ± 1.47	4.17 a ± 0.33	4.16 ab ±2.92	4.18 ab ± 2.18	3.92 b-d ± 1.08	3.24c ± 0.91	23.68 cd ± 1.15
4	Toast with 10% CBRG	3.77 c ± 2.03	3.00 e ± 1.18	3.42 cd ± 2.05	4.17 ab ± 0.99	4.00 bc ± 0.07	3.50 bc ± 0.45	22.06 f ± 1.11
5	Toast with 10% PBRG	3.00e ± 1.90	3.25 d ±1.22	3.42 cd ± 2.10	3.67 cd ±1.06	3.58 cd ± 0.24	3.42 bc ±1.97	20.34 h ± 0.86
6	Toast with 15% CBRG	4.41 a ± 1.38	3.92 b ± 2.04	4.55 a ± 3.17	3.97 bc ± 2.59	4.37 ab ± 2.24	3.48 bc ± 1.08	24.70 a ± 2.01
7	Toast with 15% PBRG	4.12 b ±1.19	3.78 b ± 1.43	4.13 ab ± 2.14	4.11 ab ± 0.36	4.62 a ± 1.25	4.19 a ± 1.48	21.24 g ± 0.96
8	Toast with 20% CBRG	2.92 e ± 3.05	2.83 e ± 1.56	3.08 d ± 1.87	3.42 d ± 0.57	3.42 d ± 0.29	3.42 bc ± 1.36	23.09 e ± 2.17
9	Toast with 20% PBRG	3.25 d ± 0.93	3.33 cd ± 2.18	4.17 ab ± 0.13	4.33 ab ± 0.87	4.17 ab ± 2.51	4.17 a ± 3.21	23.42 d ± 1.70

Values in the same column followed by different letters are significantly different ($p < 0.05$).CBRG (completed black rice grains) and PBRG (peeled black rice grains).

It was noticed that toast with 15% CBRG was the highest taste score as (4.41) followed by toast with 5% CBRG and 15% PBRG as (4.12) for both of them. On the other hand, toast with 15% CBRG was the highest taste, internal colour and over all acceptability scores as (4.41, 4.55 and 4.18), respectively. Colour is a very important criterion for the initial acceptability of the baked products by the consumer. Moreover, as the development of colour occurs classically during the later stages of baking, it can be used to judge completion of the baking process. Darkness in the internal crust colour of the composite bread was observed as the level of the supplementation of black rice increased which may be attributed to the black colour (Makinde and Akinoso, 2014). Toast bread with 15% PBRG scored more points in texture and over all acceptability than control as (4.62) and (4.07), respectively. On the other hand, toast with 5% CBRG was the most external colour as (4.51). For odour, taste with 5% PBRG was the highest odour score as (4.17).

Toast with 15% CBRG was the highest overall acceptability as (24.70) followed by toast with 5% CBRG as (24.19) comparing with control as (23.99) with being toast with 10% PBRG the lowest over all acceptability score as (20.34).This confirms that the completed grains powder preparations from black rice have great potential in food applications. These results in agreement with those of Sangnarkand and Noomhorm (2003) and Serrem *et al*., (2011).

Rheological parameters of dough of black rice toast bread

Rheological properties of dough formula prepared from different levels of CBRG and PBRG flour were determined by farinograph and extentsograph tests and the results were presented in Table (2), Fig. 1 and 2. Farinograph parameter revealed that water absorption of dough decreased compared with control toast (76.50%) followed by dough with 5% CBRG (67.20%) where dough with 10% PBRG was the lowest water absorption of dough as (60.80%), these results are in accordance with those of Hemedam and Khatab (2010). With regarded to the arrival time, dough development time and dough stability values were directly affected by the addition of CBRG and PBRG ratios. Dough with 10% CBRG was the highest arrival time and development time values as (3.00, 4.00min), respectively. Dough stability values were found to be higher in all toast doughs than the control dough except for dough with 20% CBRG (12.00 min) worthly as control where dough sample of 20% PBRG was the highest dough stability value as (14.50 min), while dough weakening value decreased for all dough fortified samples as comparing to the control, dough with 5 and 10% CBRG as(40.00 min) for all of them with being dough with 20% CBRG the lowest dough weakening value as (10.00 min). This means that addition of CBRG and PBRG with different ratios plays an important role in pharinograph parameters of dough.

Regarding to extentsogragh, the 10% substitution of wheat flour by PBRG induced an increase in resistance to extension to (520 B.U.) comparing with control dough (490 B.U.). Extensibility was decreased by addition of CBRG and PBRG ratios, where dough with 20% PBRG (85 mm) was the lowest extensibility value (85 mm) compared with the highest (130 mm) in control dough with 20% PBRG. The highest proportional number (5.53 P.N.) was found to be in dough with 20% PBRG compared with control dough (3.77 P.N.) and a decrease in dough with 15% CBRG to (3.15 P.N.). Addition of CBRG and PBRG ratios caused dough energy (cm2) decrease in all samples except for dough with 10% PBRG (115 cm2) with being dough with 20% CBRG the lowest energy (47 cm2) comparing with dough control (102 cm2). Meanwhile dough sample with CBRG and PBRG ratios showed lower values for most extentsogragh parameters as comparing with control. These results are in agreement with those obtained by Chen *et al*., (1988), Ramy et al., (2002) and Ayo et al., (2010).

Table (2): Rheological properties of dough with CBRG and PBRG flour

Toast bread samples	Test results								
	Farinograph					Extensograph			
	Water absorption (%)	Arrival time (min)	Development time (min)	Stability time (min)	Degree of weakening (B.U) *	Resistance of extension (B.U.) *	Extensibility (mm)	Proportional number P.N.	Dough energy (cm^2)
Control toast	76.50 a ± 0.08	2.00 d ± 2.49	3.50 c ± 1.30	12.00 f ± 1.05	40.00 a ± 1.04	490 d ± 1.62	130 a ± 0.11	3.77 de ± 0.91	102 b ± 1.34
Toast with 5% CBRG	67.20 b ± 1.23	2.70 b ± 2.18	3.40 d ± 1.57	13.10 d ± 1.03	40.00 a ± 1.17	420 f ± 0.48	121 c ± 2.29	3.41 ef ± 1.35	83 d ± 1.08
Toast with 5% PBRG	62.50 g ± 1.11	1.30 f ± 1.09	2.10 f ± 0.74	13.60 bc ± 0.81	30.00 b ± 1.36	500 c ± 1.50	129 ab ± 1.18	3.91 d ± 0.27	94 c ± 1.31
Toast with 10% CBRG	64.10 d ± 1.40	3.00 a ± 0.45	4.00 a ± 1.09	13.50 c ± 2.24	40.00 a ± 2.10	400 g ± 0.49	115 d ± 1.61	3.48 e ± 1.50	70 f ± 1.12
Toast with 10% PBRG	60.80 h ± 0.35	1.50 e ± 1.98	2.00 g ± 1.84	13.50 c ± 0.63	30.00 b ± 0.94	520 a ± 0.66	128 b ± 1.07	4.06 c ± 1.19	115 a ± 0.51
Toast with 15% CBRG	64.00 e ± 1.69	2.60 c ± 2.28	3.80 b ± 2.75	12.30 e ± 1.14	20.00 c ± 1.28	350 h ± 0.47	112 e ± 1.90	3.15 f ± 1.21	62 h ± 1.05
Toast with 15% PBRG	65.40 c ± 1.51	1.30 f ± 1.70	2.20 e ± 2.06	14.10 b ± 0.94	20.00 c ± 1.72	510 b ± 1.60	114 de ± 2.25	5.20 b ± 1.87	75 e ± 1.41
Toast with 20% CBRG	63.80 ef ± 0.63	1.50 e ± 1.01	2.00 g ± 2.17	12.00 f ± 1.24	10.00 d ± 1.51	260 i ± 1.07	108 f ± 0.95	2.41 g ± 1.80	47 i ± 0.59
Toast with 20% PBRG	61.80 gh ± 0.47	1.00 g ± 1.30	2.00 g ± 1.27	14.50 a ± 0.98	20.00 c ± 1.08	470 e ± 1.35	85 g ± 0.72	5.53 a ± 1.69	64 g ± 1.13

Values in the same column followed by different letters are significantly different ($p < 0.05$). CBRG (completed black rice grains) and PBRG (peeled black rice grains).

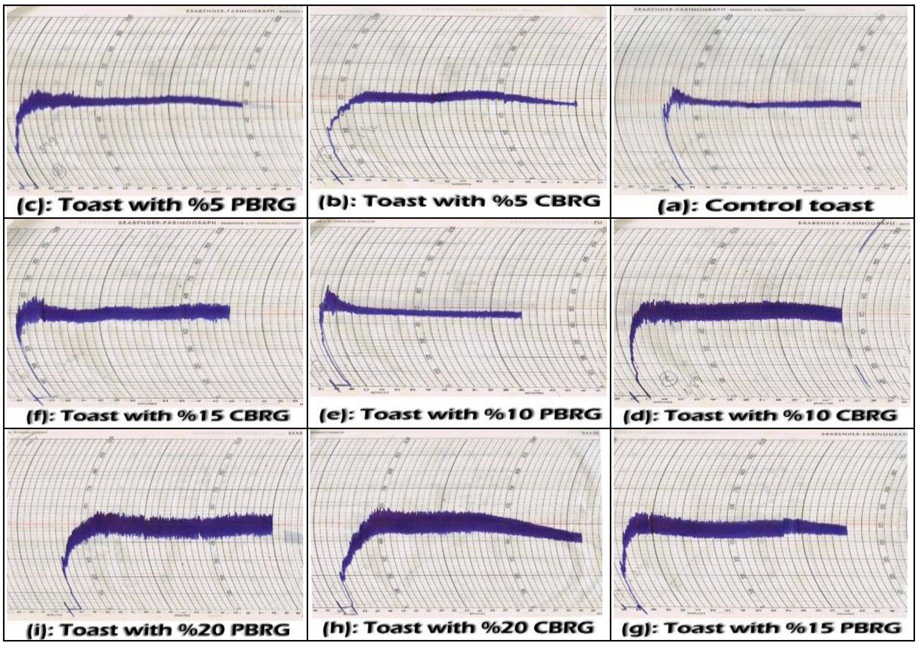

Fig. (1): Rheological properties of dough with CBRG and PBRG by farinograph

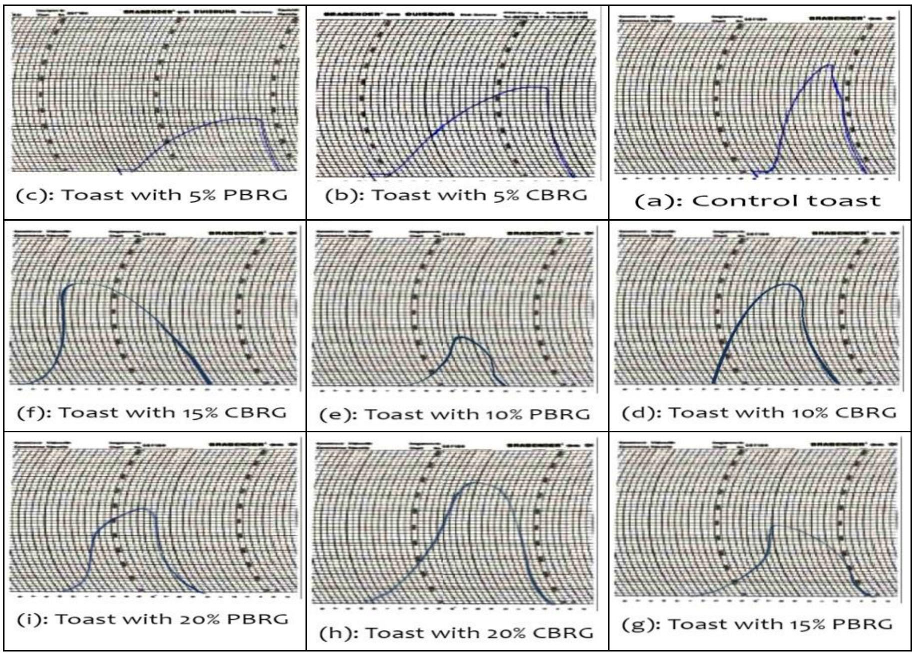

Fig. (2): Effect on rheological properties of dough with CBRG and PBRG by extentsogragh>

Proximate chemical composition of black rice toast bread

The chemical composition of toast bread prepared from CBRG and PBRG flour with different ratios in this study are presented in Table (3). Toast with 20% CBRG contained significantly high content in protein (11.06%) followed by toast with 20% PBRD (10.98%) comparing with the lowest protein content in control toast which was (9.49%) and this is because the wheat flour has lower protein content (Makinde and Akinoso, 2014). Toast with 5% PBRG was the highest fat content (16.28%) followed by toast with 5% CBRG (13.05%) comparing with the lowest fat content (4.43%) in toast with 20% PBRG and control toast (4.93%). On the other hand, toast with 20% PBRG was the highest ash content (3.22%) comparing with toast with 5% PBRG as (2.32%). For crude fiber, toast with 10% PBRG was the highest fibers content (5.82%) followed by toast with 15% PBRG (5.30%) comparing with control toast which was the lowest crude fiber content (3.70%). The highest carbohydrates content at the same time (79.07%) compared with toast with 5% PBRG (66.30%) and this agree with Boling et al., (1998) and Makinde and Akinoso, (2014). As illustrated, increasing in protein, ash and fiber and decreasing in fat and carbohydrate contents of toast samples were resulted with increasing proportion of CBRG and PBRG powder. Previous studies reported that rice bran is a rich source of fiber and considerably high protein and fat content Hu et al., (2009). An increase of fiber content in rice flour and rice bran may contribute to health benefits .It has been reported that intake more fiber resulted in increasing faecal bulk and lowering of plasma cholesterol (Varo *et al*., 1983, Seal, 2006, Chotimarkorn and Silalai, 2007 and Ayo *et al*., 2010).

Table (3): Chemical composition of toast bread made from CBRG and PBRG flour (on dry weight bases)

Toast bread samples		Chemical composition %					
		Moisture	Protein	Ether extract	Ash	Crude fiber	carbohydrates
1	Control toast	7.20 b ± 1.25	9.49 f ± 1.17	4.93 d ± 1.02	2.81 b ± 1.14	3.70 f ± 0.86	79.07 a ± 1.15
2	Toast with 5% CBRG	4.52 e ± 0.36	10.28 cd ± 1.09	13.05 b ± 1.24	2.60 b ± 1.11	3.76 ef ± 1.07	70.31 g ± 0.69
3	Toast with 5% PBRG	6.61 c ± 2.03	9.87 e ± 1.34	16.28 a ± 1.12	2.32 c ± 2.15	5.23 bc ± 1.59	66.30 h ± 1.03
4	Toast with 10% CBRG	5.70 d ± 1.11	10.47 bc ± 0.89	10.06 c ± 1.45	2.77 b ± 1.76	3.84 d-f ± 0.58	72.86 e ± 2.01
5	Toast with 10% PBRG	6.80 bc ± 1.25	10.11 de ± 1.39	9.44 c ± 1.64	2.66 b ± 0.64	5.82 a ± 1.91	71.97 f ± 1.07
6	Toast with 15% CBRG	6.67 c ± 0.97	10.65 b ± 1.23	9.25 c ± 2.24	2.69 b ± 1.30	3.92 de ± 1.49	73.49 d ± 1.78
7	Toast with 15% PBRG	6.95 bc ± 2.18	10.52 bc ± 1.35	9.03 c ± 2.09	2.89 b ± 1.14	5.30 b ± 0.72	72.26 f ± 1.41
8	Toast with 20% CBRG	7.70 a ± 1.55	11.06 a ± 1.04	4.53 d ± 0.18	2.73 b ± 0.64	3.98 d ± 2.06	77.70 b ± 1.44
9	Toast with 20% PBRG	7.00 bc ±1.13	10.98 a ± 1.82	4.43 d ± 0.98	3.22 a ± 1.07	5.09 c ± 0.88	76.28 c ± 2.34

Values in the same column followed by different letters are significantly different ($p < 0.05$). CBRG (completed black rice grains) and PBRG (peeled black rice grains).

Minerals content of black rice toast bread

These are inorganic materials present in ash when food or any living organism is cremated. The mean squares for mineral contents (Table 4) depicted that blending of CBRG and PBRG significantly improved the mineral contents of toast bread. Potassium (K) participates in certain enzymes system in the body and control acid balance along with sodium to maintain fluid balance. Maximum K content (166.48 mg/100 g) was observed in toast with 20% CBRG, followed by (154.75 mg/100g) whilst the lowest value was found in control toast as (104.76 mg/100g), followed by toast with 5% PBRG as (105.13 mg/100g).

Calcium (Ca) is essential for teeth formation and also helps in muscle contraction, maintenance of cell membranes, clotting of blood and normal functioning of nerves, muscles and heart. It participates in the activation of many enzymes (Mian et al., 2009). The highest value for Ca (134.52 mg/100 g) in toast with 20% CBRG followed by toast with 20% PBRG as (128.15 mg/100 g) comparing with minimum Ca value (70.11 mg/100 g) for control toast. Sodium (Na) is essential in the regulation of water content of the body and in maintenance of osmotic pressure of body fluids. The means for mineral contents in toast bread (Table 4) represented that maximum Na content (513.46mg/100 g) was observed in toast with 20% CBRG followed by

(501.27 mg/100g) for toast with 20% PBRG, while the lowest value (278.31 mg/100 g) was found in control toast.

Table (4): Minerals content of bread made from CBRG and PBRG flour

Toast bread samples		Minerals (mg/100g)						
		K	Ca	Na	Mg	Fe	Zn	P
1	Control toast	104.76 h ± 2.03	70.11i ± 1.25	278.31i ± 2.11	74.88 g ± 1.69	1.97 h ± 1.57	1.01 e ± 2.14	194.07 i ± 2.45
2	Toast with 5% CBRG	108.89 g ± 2.50	103.25 g ± 0.18	396.04 g ± 2.10	76.45 f ± 1.68	76.46 g ± 1.35	1.32 d ± 2.08	225.13 g ± 1.46
3	Toast with 5% PBRG	105.13 h ± 1.56	99.04 h ± 2.02	360.92 h ± 1.38	76.21 f ± 1.79	1.87 i ± 2.25	1.27 d ± 0.68	217.64 h ± 1.24
4	Toast with 10% CBRG	119.59 e ± 1.92	120.38 e ± 1.47	451.37 e ± 0.33	82.65 d ± 0.94	3.56 e ±2.07	1.52 c ± 1.41	242.38 e ± 0.73
5	Toast with 10% PBRG	117.60 f ± 2.08	113.66 f ± 1.91	438.94 f ± 2.58	80.93 e ± 0.81	3.08 f ± 2.06	1.39 cd ± 1.94	231.61 f ± 0.62
6	Toast with 15% CBRG	129.71 c ± 1.14	126.19 c ± 1.37	488.47 c ± 2.08	89.42 a ± 1.28	4.00 c ± 0.78	2.71 a ± 0.58	278.23 c ± 0.27
7	Toast with 15% PBRG	122.03 d ± 0.80	122.08 d ± 1.24	452.19 d ± 1.39	85.31 c ± 0.64	3.91 d ± 2.84	2.36 b ± 0.90	261.79 d ± 1.33
8	Toast with 20% CBRG	166.48 a ± 1.04	134.52 a ± 2.66	513.46 a ± 2.51	89.74 a ± 0.55	4.32 a ± 1.47	2.33 b ± 0.36	326.58 a ± 1.15
9	Toast with 20% PBRG	154.75 b ± 2.03	128.15 b ± 1.64	501.27 b ± 2.11	87.76 b ± 2.08	4.23 b ± 1.53	2.21 b ± 1.80	315.06 b ± 1.34

Values in the same column followed by different letters are significantly different ($p < 0.05$).CBRG (completed black rice grains) and PBRG (peeled black rice grains).

Magnesium (Mg) is essential in the formation of bones and teeth and synthesis of proteins. It is also involved in maintenance of muscle functions, release of energy from muscle glycogen and conduction of nerve impulse. Maximum Mg content (89.74 mg/100 g) was found in toast with 20% CBRG comparing with the lowest Mg content (74.88 mg/100 g) for control toast. It was noticed that toast with 20% CBRG contain the highest Fe and P content as (4.32 and 326.58 mg/100 g), respectively, while toast with 15% CBRG was the highest Zn content as (2.71 mg/100 g). On the other hand, toast with 5% PBRG was the lowest Fe and Zn contents as (1.87 and 1.27 mg/100 g), respectively. It is obvious from the results that CBRG and PBRG supplementation significantly improved the mineral contents of toast bread, except for sodium; with proportionate increase of supplementation agree with Thompson, (2005), Sharif et al., (2009) and Makinde and Akinoso, (2014).

Biological assay

Effect of CBRG and PBRG on growth parameters

Results in Table (5) show that there was clear increasing in final weight for all rats groups except for positive (+) control group, which had slowly increasing from 93.08 to 98.13 g. It was noticed that the differences were significant between rats fed on toast with 20% CBRG which had the highest final weight to 183.40 g followed by 180.89 g for rats fed on toast with PBRG comparing with the lowest final weight 98.13 for positive (+) control group. On the other hand, rats fed on toast with 20% CBRG also had the maximum weight gain (101.20%) followed by rats fed on toast with 15% PBRG (95.99%) with being positive control (+) the lowest weight gain (5.42%). Concerning food intake, there was a slight increase in food intake value between control groups (- ve and + ve), the mean values were 17.98 and 16.72 g, respectively. Rats fed on toast with 20% CBRG had the highest food intake value (18.24 g) followed by (18.20 g) for rats fed on toast with 5% PBRG. Food intake value was not differing significantly between rats groups fed on toast with 10% PBRG, control toast and negative control. Control groups (- ve and + ve) were the same protein intake value (1.26). Rats fed on toast with 20% CBRG had the highest protein intake value as 1.86 g followed by 1.76 g for rats fed on toast with 20% PBRG. Protein intake value was not differing significantly between rats groups fed on toast with 15, 20% CBRG and 15, 20% PBRG compared with the lowest protein intake 1.20 g in rats fed on toast with 5% PBRG.

Table (5): Growth parameters of hypercholesterolemic rats fed on CBRG and PBRG.

Variables / Rat groups	Initial weight (g)	Final weight (g)	Weight gain (%)	Food intake (g)	Protein intake (g)	Food efficiency ratio (FER)	Protein efficiency ratio (PER)
G1: control (-)	91.65 e ± 1.12	158.34 g ± 1.36	72.76 g ± 0.97	17.98 ab ± 1.25	1.26 de ± 1.41	3.70 d ± 0.37	52.92 a ± 0.84
G2: control (+)	93.08 c ± 0.29	98.13 k ± 0.58	5.42 k ± 0.81	16.72 d ± 0.64	1.26 de ± 1.01	0.30 g ± 0.73	40.00d ± 1.22
G3: Control toast	91.12gh ± 0.68	147.56j ± 1.15	61.94i ± 1.36	17.45bc ± 0.91	1.28de ± 1.46	3.23 ef ± 0.79	44.09 c ± 0.60
G4: 5% CBRG	92.75 c ± 1.77	153.19 h ±1.32	65.16 h ±0.58	17.03 cd ± 1.11	1.34 de ± 0.97	3.54 de ± 1.18	45.10 c ± 0.45
G5: 5% PBRG	93.64 b ± 1.29	148.47 i ± 0.36	58.55 j ± 1.64	18.20 a ± 1.03	1.20 e ± 1.16	3.01 f ± 1.20	45.69 c ± 0.97
G6: 10% CBRG	91.48 ef ± 1.05	166.35 e ±1.39	81.84 e ± 1.27	16.89 cd ± 0.88	1.47 cd ± 0.98	4.43 bc ±1.07	50.93ab ± 1.05
G7: 10% PBRG	92.33 d ± 1.03	164.18 f ±1.16	77.81 f ± 0.92	17.46 bc ±0.87	1.62 bc ± 1.06	4.11 c ± 0.86	44.35 c ±1.08
G8: 15% CBRG	90.79 h ±1.09	176.02 c ± 1.31	93.87 c ±1.18	16.91 cd ± 0.85	1.65 a-c ±1.19	5.04 a ± 1.00	51.65 ab ± 1.08
G9: 15% PBRG	89.46 i ±1.14	175.34 d ± 1.37	95.99 b ± 0.85	18.07 a ± 1.08	1.73 ab ±0.99	4.75 ab ± 1.10	49.64 ab ± 0.95
G10: 20% CBRG	91.15 fg ±0.18	183.40 a ± 0.23	101.20a ± 1.51	18.24a ± 0.67	1.86a ± 1.69	5.05a ± 0.39	49.59ab ± 1.07
G11: 20% PBRG	94.10a ±1.54	180.89b ± 1.38	92.23d ± 1.09	17.81ab ± 1.14	1.76ab ± 0.81	4.87a ± 1.10	49.31b ± 0.41

Values in the same column followed by different letters are significantly different ($p < 0.05$).CBRG (completed black rice grains) and PBRG (peeled black rice grains).

Concerning food efficiency ratio (FER) there were significant differences ($P<0.05$) between both control groups (- ve and + ve) and cholesterolemic groups fed on black rice toast. Rats fed on toast with 20% CBRG had the highest FER at all as 5.05 followed by rats fed on toast with 15% CBRG then rats fed on 20% PBRG as 4.87 comparing with both control groups (- ve and + ve). Concerning Protein efficiency ratio (PER), there was significant differs between control groups (- ve and + ve) as 52.92 and 40.00, respectively. Rats fed on toast with 15% CBRG had the second highest protein intake value (51.65) followed by 50.93 for rats fed on toast with 10% CBRG. Protein intake value was not differing significantly between rats groups fed on toast with 15, 10% CBRG, 15% PBRG, 20% CBRG and negative control. These results are in agreement with those obtained by Hemedam and Khatab (2010).

Effect of CBRG and PBRG on serum lipid profile

Serum lipids profiles of different groups are presented in Table (6). The results indicate significant ($p<0.05$) elevation in TC, TG, LDL-C and VLDL-C accompanied by reduction in HDL-c in positive control group (+) (26.48 mg/dl) as comparing with the highest HDL-c in rats fed on 20% CBRG (53.48 mg/dl) followed by (49.33 mg/dl) for rats fed on toast with 20% PBRG. It was noticed that positive group had the highest TC, TG, LDL-c and VLDL-c values (161.03, 125.17, 109.52 and 25.03 mg/dl, respectively), followed by rats fed on control toast (98.72, 104.51, 47.63 and 20.90 mg/dl, respectively). In rats groups fed on toast with CBRG and PBRG, lipid parameters were significantly ($p<0.05$) improved comparing with control (+ ve) group. These results agree with those obtained by Thompson et al., (2005) and Seal, (2006).

Table (6): Serum lipid profile of cholesterolemic rats fed on CBRG and PBRG

Lipid profile / Rat groups	Total cholesterol (TC) (mg/dl)	Triacylglyceride (TG) (mg/dl)	HDL-c (mg/dl)	LDL-c (mg/dl)	VLDL-c (mg/dl)
G1: control (-)	89.54 d ± 0.14	81.29 g ± 1.09	47.09 c ± 2.21	26.20 e ± 0.47	16.25 g ± 0.67
G2: control (+)	161.03 a ± 1.71	125.17 a ± 2.01	26.48 k ± 1.65	109.52 a ± 1.34	25.03 a ± 1.57
G3: Control toast	98.72 b ± 0.92	104.51 b ± 0.88	30.19 j ± 1.63	47.63 b ± 1.28	20.90 b ± 1.30
G4: 5% CBRG	81.44 f ± 1.89	83.59 f ± 1.07	34.71 h ± 0.58	30.02 c ± 1.06	16.71 f ± 2.40
G5: 5% PBRG	69.15 j ± 2.24	72.41 j ± 1.36	31.16 i ± 1.68	23.51 f ± 0.62	14.48 i ± 1.11
G6: 10% CBRG	64.35 k ± 1.35	86.14 e ± 1.83	40.38 f ± 2.05	6.75 k ± 0.49	17.22 g ± 1.33
G7: 10% PBRG	71.67 i ± 0.95	74.59 i ± 2.61	38.27 g ± 1.99	18.55 h ± 0.48	14.85 h ± 0.98
G8: 15% CBRG	87.35 e ± 1.22	91.62 d ± 1.08	41.95 d ± 2.13	27.08 d ± 2.55	18.32 d ± 1.87
G9: 15% PBRG	72.10 h ± 1.34	75.03 h ± 2.03	41.06 e ± 2.18	16.04 i ± 2.41	15.00 h ± 1.85
G10: 20% CBRG	94.52 c ± 0.58	98.47 c ± 1.00	53.48 a ± 1.67	21.35 g ± 0.65	19.69 c ± 0.71
G11: 20% PBRG	76.88 g ± 2.62	81.25 g ± 0.56	49.33 b ± 0.24	11.30 j ± 0.16	16.25 g ± 1.93

Values in the same column followed by different letters are significantly different ($p < 0.05$).CBRG (completed black rice grains) and PBRG (peeled black rice grains).

Effect of CBRG and PBRG on hematological parameters

The results in Table (7) revealed that there were slightly no-significant decrease between control (- ve and + ve) groups in hematological parameters RBCs and WBCs. Feeding rats on toast with 20% CBRG introduced the highest Hb value (14.80 g/dl) followed by (14.72 g/dl) in rats fed on toast with 20% PBRG compared with (11.96 g/dl) in control (+ ve) group.

Table (7): Hematological parameters of hypercholesterolemic rats feed on CBRG and PBRG.

Parameters / Rat groups	Hb (g/dl)	HT (%)	RBCs 10^3	WBCs 10^6
G1: control (-)	14.21 cd ± 0.25	46.53 a ± 0.39	7.25 a ± 0.11	5.67 a ± 0.64
G2: control (+)	11.96 g ± 0.87	37.28 h ± 0.14	6.62 b ± 0.85	5.94 a ± 0.36
G3: Control toast	12.03 g ± 0.35	38.27 g ± 0.58	6.09 d ± 0.07	3.71 de ± 0.41
G4: 5% CBRG	12.81 f ± 0.10	39.14 f ± .05	6.57 b ± 0.32	3.65 de ± .18
G5: 5% PBRG	12.85 f ± 0.42	39.68 f ± 0.92	6.48 bc ± 0.20	4.97 b ± 0.85
G6: 10% CBRG	13.53 e ± 0.17	41.09 e ± 0.51	6.50 b ± 0.64	3.42 e ± 0.11
G7: 10% PBRG	13.27 e ± 0.65	41.33 de ± 0.55	6.43 b-d ± 0.62	4.90 b ± 0.03
G8: 15% CBRG	14.37 bc ± 0.72	42.15 c ± 0.31	6.12 d ± 0.02	3.58 de ± 0.66
G9: 15% PBRG	13.89 d ± 0.12	41.88 cd ± 0.04	6.15 cd ± 0.56	4.62 c ± 0.73
G10: 20% CBRG	14.80 a ± 0.64	44.63 b ± 0.48	7.01 a ± 0.09	3.74 d ± 0.06
G11: 20% PBRG	14.72 ab ± 0.76	44.48 b ± 0.51	6.98 a ± 0.08	4.39 c ± 0.13

Values in the same column followed by different letters are significantly different ($p < 0.05$).CBRG (completed black rice grains) and PBRG (peeled black rice grains).

The maximum HT percentage was found to be 46.53% in control (- ve) group followed by (44.63, 44.48%) rats fed on toast with 20% CBRG and 20% PBRG, respectively, compared with control (+ ve) group (37.28%).

While there was significant drop in RBCs count comparing with both control groups (- ve and + ve) which recorded 7.25 and 6.62, respectively. On the other hand, there was no-significant differences between RBCs count in control (- ve) group as 7.25 and rats fed on toast with 20% CBRG and 20% PBRG which recorded 7.01 and 6.98, respectively.

There was significant ($p<0.05$) decrease in WBCs count comparing with both control (- ve and + ve) groups which recorded 5.67 and 5.94, respectively. Meanwhile, feeding rats on toast with 10% PBRG recorded a marked hematological effect on WBCs count as 4.90 compared with 3.42 in rats fed on toast with 10% CBRG. These results are in agreement with

Thompson *et al*., (2005). The present results are in agreement with those obtained by Akahane *et al*., (1986), who reported that rats given cholesterol in the diet, a decrease in hematocrit level after about 2 weeks of feeding. The present results can be explained as reported by Boling *et al*., (1998), who reported that use of seed in diet decrease plasma iron level, which may bond with iron in intestine or liver and lead to low levels of HGB and HCT in blood.

CONCLUSION

This study has demonstrated that addition of completed black rice grains CBRG and peeled black rice grains PBRG were found to increase protein, fiber and ash contents in toast bread. More importantly, may contribute to health benefits by increasing faecal bulk and lowering of plasma cholesterol. Toast bread could be made from a significant proportion of CBRG and PBRG with an overall acceptability and considered as a good functional ingredient for adding value of food product. In rats groups fed on toast with CBRG and PBRG, the lipid and hematological parameters were significantly ($p<0.05$) improved as compared with control (+ ve) group.

REFERENCE

(AACC) (1983)American Assoction of Cereal Chemists. Approved methods of AACC 8th. Ed. inc., st., banl. mirn., U.S.A.

Akahane, K.; K. Furuhama and T. Onodera (1986): Simultaneous occurrence of hypercholesterolemia and hemolytic anemia in rats fed cholesterol diet. Life Science, 39(6): 499-505.

(AOAC) (2000) Association of Official Analytical Chemists. Official methods of analysis; 17th ed. Washington, DC., USA.

Ayo, J. A.; Ikuomola, D. S.; Esan, Y. O.; Onuoha, O. G.; Ayo, V. A. and Ekele, V. (2010). Effect of added defatted beniseed on the quality of acha based biscuits. Continental Journal of Food Science and Technology 4: 7 – 13.

Boling, S. D.; H. M. Edwards; J. L. Emmert; R. R. Bihel and d. H. Baker (1998): Bioavailability of iron in cottonseed meal, ferric sulfate and two ferrous sulfate byproducts of the galvanaizing industry. Poul. Sci., 77: 1388-1392.

Campbell, J.A. (1963). Methodology of protein evaluation. RAG. Nuti. Document, R.10.37, June Metting. New York.

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.

Chen, H.; G. L. Rubentha/ar; H. K. Leung and J. D. Baranowski (1988): Chemical, physical and baking properties of apple fiber compared with wheat and oat bran. Cereal Chem., 65 (3): 244.

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

El-Khamissy, A. (2005). Studies on biological effects of some diabetes food. Ph.D. thesis, Dep. of Home Economics, Fac. Of Specific Education, Tanta Univ., Egypt.

Elleuch, M.; D. Bedigian; O, Roiseux; S. Besbes; C. Blecker and H. Attia (2011). Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications. Food Chemistry 124: 411-421.

El-Nemer, I. M. (1976). Investigation of the effect of various grain meals that could be employed in preparing Egyptian wheat bread. Ph.D. Thesis. Hungarian Academy Sciences, BP, Hungary.

Eneche, E.H. (1999). Biscuit-Making Potential of Millet/Pigeon Pea Flour Blends. Plant Foods Hum. Nutr., 54: 21-27.

Hemedam H. M. and Khatab, H. A. H. (2010). The impact of bottle gourd seeds husks on rheological properties of pan bread and lipid profiles in hypercholesterolemic rats. World Applied Sciences Journal 9(7: 764-778. ISSN 1818-4952.

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.

James, C. S. (1995). "Analyticl Chemistry of Foods". Chap. 6, General food studies, firsted., the alden press, Oxford, UK.

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

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

Kim, M. and H. K. Shin (1998). The water soluble of chicory influences serum and liver lipid concentration, cecal short chain fatty acid concentration and faecal lipid excretion in rats. J. Nutr., 28 (21): 1731-1736.

Lund, D. (1982): Quantifying reactions influencing quality of foods: texture, flavor and appearance. Journal of Food Processing and Preservation, 6: 133-153.

Liu, G.; S. Choi and R.W. Tsien (1999). Variability of meurotransmitter concentration and nonsaturation of postsynaptic AMPA receptors at synapses in hippocampl cultures and slices. Neuron 22: 395-409.

Lopz-virella, M. F.; P. Stone; S. Ellis and J.A. Coweel (1977). Cholesterol determination in HDL separated by three different methods. Clin. Chem., 23:882.

Lund, D. (1982): Quantifying reactions influencing quality of foods: texture, flavor and appearance. Journal of Food Processing and Preservation, 6: 133-153.

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

Mian, K. S,; M. S. Butt; F. M. Anjum and H. Nawaz (2009). Preparation of fiber and mineral enriched defatted rice bran supplemented cookies. Pakistan Journal of Nutrition, 8: 571-577.

Moskowitz, H.R. and Krieger, B. (1995): The contribution of sensory liking to overall liking: an analysis of six food categories. Food Quality and Preference, 6: 83-90.

Murphy, C. (1985): Cognitive and chemosensory influences on age- related Changes in the ability to identify blended foods. Journal of Gerontology, 40:47-52.

Pearson, D. (1971). The Chemical Analysis of Foods. National College of Food Technology, 8: J. and A. Cherchill, London.

Pearson, D. (1991). Composition and analysis of food. 9th ed. Churhill, London, U. K.

Rabie, M. M.; A. M. Hassan; M. Abou-Raya; A. Ezzat and O. Al Adl (2009). Effect of fatty matters on dough rheological properties and sensory evaluation of bakery products. J.Agric. Sci. Mansoura Univ., 34 (4): 2911-2921.

Ramy, A.; M.F. Salama and A.A. Souk (2002): Pollardas potential source of dietary fiber for pasta manufacture. Egypt. J. Food Sci., 30 (2): 313-330.

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.

Richmond, W., (1973).Clin. Chem., 19: 1350.

Sangnarkand, A. and A. Noomhorm (2003): Effect of particle sizes on functional properties of dietry fiber prepared from sugarcane bagasse. Food Chemistry, 80: 221-229.

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

Schutz, H.G. and Wahl, O. L. (1981): Consumer perception of the relative importance of appearance, flavor and texture to food acceptance. In: Criteria for Food Acceptance. How Man Chooses What He Eats. J. Solm and R. L. Hall (eds.) Forster Publishing Ltd. Switzerland, p. 97-116.

Seal, C. J. (2006): Whole grains and CVD risk. Proceed Nutr., Soc.; 65:24-34.

Serrem, C.; H. Kock and J. Taylor (2011). Nutritional quality, sensory quality and consumer acceptability of sorghum and bread wheat biscuits fortified with defatted soy flour. International Journal of Food Science and Technology 46: 74-83.

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

Sidkey, H. M.; Abou-Zaid and H. I. Meatuk (1993). Study on the use of natural color in candy. Presented at Natural Colors for the food industry Conference, Suiz Canal Univ., Ismailia, Egypt.

Skottova, N.; V. Krecman; D. Walterova; J. Ulrichova; P. Kosina and V. Simanek (1998). Effect of silymarin on serum cholesterol levels in rats. Acta. Univ. Palacki. Olomc.,141: 87-89.

Steel, R. G. and H. J. Torrie (1980). Principles and procedures of statistic. (2nd ed.) pp. 120. Mc Graw-Hill, New York USA.

Suzuki, M.; T. Kimura; K. Yamagishi; H. Shinmoto and K. Yamaki (2004). Comparison of mineral contents in 8 cultivars of pigmented brown rice. Nippon Shokuhin Kagaku KogakuKaishi, 51(8): 424-427.

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

Varo, P.; R. Laine and P. Koivistoinen (1983): Effect of heat treatment on dietary fibre: Interlaboratory study. J. Association Analysis Chem., 66(4): 933-938.

Wang, M. Y.; S. C. Liu. Shen; C. C. Wang and M. S. Kuo (2007). Measurement of trace amountsof beryllium in olive leaves by graphite-furance atomic absorption spectrophotometry using acetylacetone as a chelating agent. Tunghai Science. 10: 11-26.

تحسين خواص جودة خبز التوست باستخدام دقيق الأرز الأسمر

لمياء محمود لطفي

قسم الاقتصاد المنزلي، كلية التربية النوعية، جامعة كفر الشيخ، مصر

تم استخدام دقيق الأرز الأسمر الكامل ودقيق الأرز الأسمر المقشور في اعداد خبز التوست لزيادة قيمته الغذائية. حيث تم استبدال دقيق القمح (WF) بدقيق الأرز الأسمر الكامل (CBRG) ودقيق الأرز الأسمر المقشور (PBRG) بنسب ٥، ١٠، ١٥ و ٢٠%. تكونت ٨ خلطات جيدة استخدمت لعمل ٨ أنواع من خبز التوست الخافض للكوليستيرول وتم تقدير القبول الحسي والخواص الريولوجية والتركيب الكيماوي والمعادن وحالة الدم والتأثير الحيوي على دهون الدم في الفئران المصابة بارتفاع كولستيرول الدم.

فيما يخص الخواص الحسية، فقد سجل التوست المعد باستخدام ١٥% من دقيق الأرز الأسمر الكامل أعلى قيمة للطعم واللون الداخلي والقبول العام بواقع (٤.٤١، ٤.٥٥ و٤.١٨) على التوالي ولم تتواجد فروق معنوية بين كل المعاملات وبين توست الكنترول. كما أشارت النتائج الى تواجد أعلى قيم للبروتين (١١.٠٦%) بالتوست ٢٠% من دقيق الأرز الأسمر الكامل في حين كان التوست ٢٠% من دقيق الأرز الأسمر المقشور أقل قيمة للرماد بواقع (٣.٢٢%)، وتوست ١٠% من دقيق الأرز الأسمر المقشور أعلى قيمة للألياف (٥.٨٢%).

بالنسبة للخواص الريولوجية، فقد تفوقت معاملات الدقيق تفوقاً معنوياً مقارنة بكنترول التوست. حيث تناقصت سعة امتصاص العجينة للماء الى (٦٠.٨٠%) في التوست المحتوي ١٠% الأرز الأسمر المقشور. تواجدت أعلى قيم لزمن الوصول والتطور للعجينة في توست ١٠% الأرز الأسمر الكامل بواقع (٣.٠٠ و٤.٠٠) على التوالي. كما وجدت أعلى قيم لزمن استقرار العجينة في كل المعاملات ما عدا عجينة توست ٢٠% الأرز الأسمر الكامل بواقع (١٢.٠٠). في حين كانت عجينة ٢٠% الأرز الأسمر الكامل أقل قيمة للضعف بواقع (١٠.٠٠). أدى استبدال دقيق القمح بالأرز الأسمر المقشور الى زيادة قيمة المرونة الى (520 B.U.) في حين كانت أقل قيمة للمرونة (٨٥.٠٠) في عجينة التوست ٢٠% الأرز الأسمر المقشور. كان أعلى رقم نسبي (5.53 P.N.) في عجينة ٢٠% الأرز الأسمر المقشور وأقل قيمة للطاقة (٤٧.٠٠) في عجينة ٢٠% الأرز الأسمر الكامل.

تواجدت أعلى قيمة للاستفادة من البروتين (FER) لدى الفئران التي تتغذي على توست ٢٠% الأرز الأسمر الكامل بواقع (٥.٠٥) مع عدم وجود فروق معنوية في البروتين المتناول بين كل مجموعات الفئران المتغذية على توست ١٥، ١٠، ٢٠% الأرز الأسمر الكامل، ١٥% الأرز الأسمر المقشور وفئران المجموعة السالبة. وقد لوحظ وجود ارتفاع في قيم HDL-C الكولستيرول عالي الكثافة (٥٣.٤٨ ملجم/لتر دم) لدى الفئران المتغذية على توست ٢٠% الأرز الأسمر الكامل. ارتفعت قيم الكولستيرول الكلي، الجليسريدات الثلاثية، LDL-C وVLDL-C بواقع (١٦١.٠٣، ١٢٥.١٧، ١٠٩.٥٢ و٢٥.٠٣ ملجم/لتر دم) على التوالي في مجموعة الفئران الموجبة ما أشار إلى وجود تحسن معنوي في مقاييس دهون وأمراض الدم لدى الفئران التي تغذت على توست الأرز الأسمر الكامل وتوست الأرز الأسمر المقشور.

تواجدت أعلى قيم لهيموجلوبين الدم لدى الفئران التي تغذت على توست ٢٠% الأرز الأسمر الكامل بواقع (١٤.٨٠ جم/لتر دم) كما أن تغذية الفئران على توست ١٠% الأرز الأسمر المقشور أدت الى زيادة ملحوظة في عدد كرات الدم البيضاء الى ٤.٩٠ مقارنة بعدد ٣.٤٢ لدى مجموعة الفئران التي تغذت على توست ١٠% الأرز الأسمر المقشور. أوضحت هذه الدراسة جلياً أن إضافة دقيق الأرز الأسمر الكامل والمقشور يمكن اعتبارها اضافة غذائية وظيفية جيدة لمنتجات الغذاء، والأكثر أهمية أنها تفيد الصحة من خلال تحسين قياسات الدهون والدم في الفئران المتغذية على النسب المختلفة من دقيق الأرز الأسمر الكامل والمقشور.