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Processing Cookies from Defatted Thermal Stabilized Black Rice Bran

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ABSTRACT

Rice bran, considered a rice milling process by- products containing a large amount of valuable components namely proteins, carbohydrates and other photochemical that exhibit health benefits.Gross chemical composition and minerals contents for both of un-stabilized and stabilized black rice bran were determined . Black rice bran has nearly the same content of protein ,fat and ash in compared with control one. Cookies were processed from black stabilized rice bran with the replacement of wheat flour 72% .Results of chemical constitutes showed that protein, ash and crude fiber of prepared cookies which contained 25% of microwave defatted black rice bran recorded the highest values were 13.97, 3.10 and 4.12 %, respectively., also, using of microwave defatted black rice bran increased mineral contents of prepared cookies namely calcium and phosphorus Results of sensory evaluation indicated that , addition of microwave defatted black rice bran at the concentration of 5% has nearly the same score of taste and odor for control sample

INTRODUCTION

Rice bran is resulted from the rice milling process rated from 5 to 10 % of milling rice. It contains major components as proteins, minerals and other phytochemicals components that are awesome for health. (Sereewatthanawut *et al*., 2008 and Kahlon, 2009).

Lipases, Lipoxygenases and peroxidase refer to the phenomenon of instability during storage, which presented in external layers of the rice kernel, they are major responsible for the hydrolysis of triglycerides into glycerol and free fatty acids (Orthoefer, 2005). To prevent rice bran from turning into rancid, lipase activity must be stopped by way of some stabilization process directly after the milling process

Stabilization is an effective treatment turning rice milling by-products into valuable dietary constituents, Therefore, the rice bran needs to be either stabilized or further processed into different fractions for food application. (Sibakov *et al.,* 2013).

Biscuit is used in the European nations and cookies in the USA. Biscuits and cookies like products have been made and eaten by man for hundreds of years (Hoseney, 1986). Cookies are best for nutrient availability, palatability, compactness, and convenience. They vary from different baked products like bread and cakes because of having lower moisture content, consist of notably unfastened from microbial spoilage and confer long shelf lifestyles of the product (Wade, 1988).

Stabilized rice bran flour in order to enrich wheat flour as a source of dietary fiber, in the preparation of frozen pizza and they also evaluated physical, chemical rheological and sensorial characteristics of the pizzas during the storage period of 2 months at -18 °C. It is observed that increasing the stabilized rice bran content results increase crude fat, ash and dietary fiber content of pizza dough. Delahaye *et al.,* (2005).

The amount of chemical constitutes fractions namely , Moisture, protein, oil extract and mineral contents, common width, thickness and spread factor of cookies increased with the increase in the percentage of rice bran. Also show that replacement of heat stabilized rice bran up to 11% is more appropriate for manufacturing of cookies. (Younus *et al.,* 2011)

So, this work was a trial to utilize brown rice bran after Microwave stability process in cookies processing as new food industries product in the Egyptian market .

MATERIALS

Rice bran samples:

Black rice bran was obtained from the milling of black rice variety (*Oryza sativa* L.). Rice bran sample was obtained during the season of 2015 from Rice Research and Training Center (RRTC) at Sakha, Kafrelsheikh Governorate, Egypt. Other chemicals substances had been of analytical reagent grade were used.

Wheat flour:

Wheat flour (72% extraction) was purchased from Delta Middle and West Milling Company, Tanta, Egypt.

Other ingredients:

Sugar, eggs, corn oil and baking powder were purchased from local market at Kafrelsheikh City, Egypt.

Rice bran stabilization:

Both types of rice bran samples (brown and black) were subject to different stabilization method as follow:

Unstabilized rice bran (Un-RB):

Rice bran without any stabilization treatment.

Microwave stabilized rice bran (MW-RB):

Rice bran was stabilized using a microwave oven (LG-550W) at level 6 for 3 minutes and manually mixed every minute, then stabilized samples were allowed to cool at room temperature. Finally packed in plastic polypropylene bags and stored in a freezer at -12ºC until further analyses. (Faria *et al.,* 2012).

Parboiled rice bran (PAR-RB):

Paddy Rice obtained after boiling at 100 ºC for 20 minutes, then steamed under pressure (1.5 kg/cm2) at 121ºC for 15 minutes. Parboiled rice was dried in an air oven at 55ºC until constant weight was reached before normal milling. (El-Bana, 2003).

Gross chemical composition of rice bran

Moisture, ash, crude fat, crude protein and crude fibre contents were determined according to the methods of A.O.A.C. (2005), while total carbohydrates was calculated by the difference.

Preparation of cookies:

The preparation of cookies was carried out using the method described by Hooda and Jood (2005) as follows: flour blends containing 5,10,15,20 and 25% of microwave defatted black rice bran flours (MW-DBLRB) was used as a replacement of wheat flour (72%extraction).

The cookies formulas were shown in Table (1). The cookies were backed in an electric oven at 175± 5ºC for 30min. Baked cookies was placed at room temperature to cool for 5 min. before serving for the sensory evaluation.

Table A. Ingredients used in cookies processing .

Ratio Ingredients	Control	5%	10%	15%	20%	25%
MW-DBLRB	0	25 g	50 g	75 g	100 g	125 g
Wheat Flour	500 g	475 g	450 g	425 g	400 g	375 g
Sugar	175 g	175 g	175 g	175 g	175 g	175 g
Corn oil	175 g	175 g	175 g	175 g	175 g	175 g
Whole egg	110 g	110 g	110 g	110 g	110 g	110 g
Baking powder	6 g	6 g	6 g	6 g	6 g	6 g

MW-DBLRB: Microwave defatted black rice bran.

Physical properties of prepared cookies:

Five replicates for each cookies were subjected for measuring samples, weight, diameter and height (thickness) as reported by (Zoulias *et al.*, 2002) for the measurement of cookies diameter, where 4 units were placed next to each different and the overall diameter changed into measured. Then all 4 units were rotated by 90º and the new diameter was measured. The average of the 2 measurements divided by way of 4 and become taken as the final diameter Spread ratio was expressed as diameter/height of cookies.

Organoleptic evaluation of prepared cookies:

Organoleptic evaluation of different prepared cookies was performed by a semi-trained panel of twenty members using nine-point hedonic-scale ratings for color, taste, odor, texture and overall acceptability (Watts *et al.,* 1989).

RESULTS AND DISCUSSION

Effect of stabilization methods on chemical composition (%) of black rice bran:

There are many factors affecting the chemical composition of rice bran such as the variety of rice; variation in organic compounds of the soil; fertilizers applied; climatic and environmental factor; degree of milling and the used treatments (parboiling and quick cooking), (Amissah *et al*., 2003). So, chemical composition was performed to study the previous mentioned treatments and their effects on the quality of the different rice samples.

Results of proximate chemical composition of un-stabilized and stabilized (microwave and parboiled) black rice bran were recorded in Table (1).

Table 1. Effect of stabilization methods on some chemical composition (%) of black rice bran:

Thermal Treatment	Chemical composition					
	Moisture	Protein	Fat	Ash	Fiber	carbohydrates*
Un- BLRB	9.90 [a]	15.50[c]	17.10[c]	7.50[c]	13.0[b]	59.90 [a]
MW-BLRB	9.50[b]	15.80[b]	17.80[b]	7.80[b]	11.50[c]	58.60[b]
PAR-BLRB	9.0[c]	17.30[a]	18.0[a]	8.60[a]	17.10[a]	56.10 [c]

Each value was an average of three determinations
A,b,c,…Values followed by the same letter in Colum are significantly different at P < 0.05
***Total carbohydrates was calculated by difference. Un- BLRB black rice bran (un-stabilized)**
MW- BLRB Microwave stabilized black rice bran PAR- BLRB Parboiled black rice bran .

Obtained results indicated that, the moisture contents of studied rice bran being (9.90, 9.50 and 9.0) for un-stabilized, microwave and parboiled black rice bran respectively, parboiled black rice bran had higher percentage of crude protein, fat, fiber and ash which their values were (17.30, 18.0, 17.10 and 8.60 %) respectively, in compared with un-stabilized and microwave black rice bran the obtained results partially with those of Moongngarm *et al.,* (2012).

Effect of stabilization process on minerals content of black rice bran:

Results revealed that there were nearly 8 elements were detected in brown and black rice bran samples. Results in Table (2 and 3) showed that Phosphorus, Potassium, Calcium, Magnesium and Iron were the major elements in all investigated samples, where their values for P were ranged from 1132 to 1580mg/100g, K ranged from 728.5 to 1085.5 mg/100g, Ca 43.90 to 89.1 mg/100g, Mg 79.10 to 102 mg/100g and Fe 6.20to 20.10 mg/100g of the mentioned varieties, respectively.

From these results, Parboiled black rice bran contained the highest values in all determined elements compared of among all tested rice bran samples.

Data in Table (5) indicate that there were an observed decrease in rice bran treated sample in compare with (PAPR- BRB), the amount of decrease were highly in (MW-BRB), the content of phosphors being (1132 mg/100g) in compare with (1450.10 mg/100g), the other elements could be arranged descending as follow P> K >Mg while there an adequate amount of Zn followed by Cu.

Table 2. Minerals content (mg / 100 g) of un-stabilized and stabilized black rice bran.

Minerals	Treatment		
	Un-BLRB	MW-BLRB	PAR-BLRB
Phosphorus (P)	1312	1220	1580
Potassium (K)	783.8	771.80	1085.5
Calcium (Ca)	62.30	59.30	89.1
Magnesium(Mg)	80.11	79.10	100.10
Sodium (Na)	5.50	5.20	6.80
Iron (Fe)	16.50	16.30	20.10
Zinc (Zn)	9.0	8.71	11.80
Copper (Cu)	1.52	1.44	1.89

Un-BLRB Black rice bran (Un-stabilized)
MW-BLRB Microwave stabilized black rice bran
PAR-BLRB Parboiled black rice bran.

Results of (PAR- BRB) also presented in the same tables, Phosphors was superior between all detected elements.

On the other hand, the iron content of black rice bran is higher three times than those of brown rice bran. Results indicated that black rice bran is a good source for the minerals especial obtained iron which played on important role for the schoolchildren, which mostly needs more iron to avoid the anemia especially in developing countries

These results were in accordance with those of Bhattacharya and Ali (1985) and El-Akary (1992) who reported that, mineral migrate from outer layers into endosperm during parboiling treatments. In addition black rice bran contains higher values in all determined elements compared to that of brown rice bran.

Proximate chemical composition (%) of un-stabilized and stabilized defatted black rice bran:

Data in Table (3) showed that parboiled defatted black rice (Par- DBLRB) contain the highest content of moisture which was (10.10%) followed by un-stabilization defatted black rice bran (Un-DBLRB) which recorded (9.50%) while the lowest value of moisture was (9.10%) for microwave defatted black rice bran (MW-DBLRB).

The result in the same table showed that, (Un-DBLRB) and (MW- DBLRB) contain protein content lower than that those of (PAR- DBLRB). Furthermore, parboiled process led to increasing of protein, ash and fiber. These results were in harmony with those found by Abd El-Hady (2013).

Table 3. PROXIMATE chemical composition (%) of un-stabilized and stabilized defatted black rice bran:

Treatment	Chemical composition					
	Moisture%	Protein %	Fat %	Ash %	Fiber %	carbohydrates*
Un- DBLRB	9.50^{b}	18.10^{b}	1.10^{a}	9.70^{b}	15.5^{b}	71.10^{a}
MW- DBLRB	9.10^{c}	18.20^{b}	0.70^{b}	10.1^{a}	13.7^{c}	71.00^{a}
PAR- DBLRB	10.10^{a}	20.5^{a}	1.20^{a}	10.3^{a}	21.0^{a}	68.00^{b}

Each value was an average of three determinations
Values followed by the same letter in Colum are significantly different at P < 0.05
***Total carbohydrates was calculated by difference.**
Un- DBLRB Defatted black rice bran (un-stabilized) MW- DBLRB Microwave stabilized defatted black rice bran
PAR- DBLRB Parboiled defatted black rice bran.

From the same table, it could be noticed that (Un-DBLRB) contained the highest value of carbohydrates (71.10%) followed by (MW-DBLRB) and (Par- DBLRB) which contained (71.00 % and 68.00 %) respectively.

However defatted black rice bran has higher level of protein, ash and fiber content than that of black rice bran samples. These results are in line with those found by Abd El-Galeel and El-Bana, (2012) and Patil *et al., (*2016).

Effect of adding microwave defatted black rice bran on physical characteristics of cookies:

Physical analysis of cookies is important from both consumers as well as manufacturers point of view. The spread of the cookies should be according to the specifications set by the manufacturers. Too much elasticity in the gluten and dough will spring back to give thicker cookies due to smaller diameter. Similarly, in case of too little elasticity, dough may flow after molding, resulting in thin cookies with large diameter.

Physical characteristics of processed cookies are presented in Table (4) the cookies processed with the replacement of MW-DBLRB with wheat flour had reduce in heights and diameters while increased weights comparing with control. These effects increased with the increasing amount of replacement of microwave defatted black rice bran with wheat flour. The difference in weight may be related to the ability of MW-DBLRB to retain water as reported by Abd El-Galeel and El-Bana, (2012).

Table 4. Physical characteristic of cookies processed with microwave defatted black rice flour:

Samples parameters	Control (WF)	5%MW-DBLRB	10%MW-DBLRB	15%MW-DBLRB	20%MW-DBLRB	25%MW-DBLRB
Weight (g)	9.46^{c}	9.51^{c}	9.81^{b}	9.84^{b}	10.45^{a}	10.56^{a}
Diameter(cm)D	6.45^{a}	5.03^{b}	5.43^{c}	5.04^{d}	4.74^{e}	4.56^{c}
Height (cm) H	0.81^{a}	0.78^{a}	0.76^{a}	0.64^{b}	0.52^{b}	0.51^{b}
Spread ratio(D/H)	7.96^{b}	6.44^{d}	7.14^{c}	7.87^{b}	9.11^{a}	8.94^{a}

WF: Wheat flour 72%; MW-DBLRB: Microwave defatted black rice bran.
Each value was an average of three determinations.
Values followed by the same letter in row are not significantly different at p ≤ 0.05.

There was a decreasing trend in the spread ratio of cookies with the proportionate increase of replacement. The spread ratio of cookies, prepared from different treatments ranged from 6.44 to 9.11. The maximum value was obtained (9.11) for spread ratio was observed in cookies with 20% MW-DBLRB whereas minimum (6.44) in cookies prepared from 5% microwave defatted rice bran.

Generally, the differences in physical properties of cookies may be due to the differences in chemical composition of ingredients which used in processing like, the increasing amount of fiber content lead to increasing amount of water holding capacity .The obtained results were similar to those reported for cookies prepared from defatted rice bran (Sharif *et al*., 2009 and Abd El-Galeel. and El-Bana 2012).

Chemical composition of cookies processed of microwave defatted black rice bran flour:

Results in Table (5) illustrated that, chemical composition of cookies processed of different levels of microwave defatted black rice bran flour (MW-DBLRB) manifested that the protein, ash and crude fiber contents were increased in compare with control one, in contrast carbohydrates value were decreased gradually with the increasing amount the replacement levels for microwave

defatted black rice bran. These results within a harmony with those findings by Sharif *et al*. (2009) and Abd El-Galeel and El-Bana (2012).

Protein, ash and crude fiber of processed which cookies contained 25% of microwave defatted black rice bran recorded the highest values were 13.97, 3.10 and 4.12 %, respectively compared to those of control (11.55, 0.61 and 0.95 %). This increase may be ascribed to their high content in defatted rice bran as shown in Table (3).

These results are in accordance with the findings of Younus *et al.*, (2011). It could be noted that, cookies replacement with defatted rice bran was considered more nutritive. The consumption about 100g of the sample contained 25% defatted rice bran would provide about 50% of the recommended daily requirement protein (25-30g/day) as recommended by (FAO/WHO, 1973) for children aged between 5 and 19 years. This fact suggests that cookies replacement with MW-DBLRB may be useful as food supplements for the alleviation or prevention of protein malnutrition in developing countries.

These results are in agreement with those reported by Sharif *et al.* (2009), Younus *et al.,* (2011) and Abd El-Galeel and El-Bana, (2012) for cookies supplemented with defatted rice bran.

Table 5. Chemical composition of processed cookies with ratio of microwave defatted black rice bran flour (g/100g dry weight basis):

Samples Chemical composition	Control WF	MW-DBLRB 5%	MW-DBLRB 10%	MW-DBLRB 15%	MW-DBLRB 20%	MW-DBLRB 25%
Moisture %	6.35 ^{c}	6.70^{c}	7.12^{b}	7.45 ^{ab}	7.92^{a}	8.44 ^{a}
Crude protein%	11.55^{f}	12.02^{e}	12.53^{d}	13.10 ^{c}	13.51^{b}	13.97 ^{a}
Fat %	8.01^{a}	8.00^{a}	7.97^{a}	7.95^{a}	7.96^{a}	8.00 ^{a}
Ash %	0.61^{f}	1.10^{e}	1.55 ^{d}	2.00^{c}	2.54^{b}	3.10 ^{a}
Crude fiber %	0.95^{f}	1.53 ^{e}	2.14^{d}	2.84^{c}	3.55^{b}	4.12 ^{a}
Carbohydrates %	79.83 ^{a}	78.88 ^{b}	77.95 ^{c}	76.95^{d}	75.99 ^{e}	74.93^{f}

Each value was an average of three determinations.
Values followed by the same letter in row are not significantly different at $p \leq 0.05$.
WF: Wheat flour 72%; MW-DBLRB: Microwave defatted black rice bran.

Minerals content of cookies processed of microwave defatted black rice bran flour:

Minerals play an important role in human nutrition. Some are essential for much component as hem for blood. (National Academies of Science Institute of Medicine, 2001).

The results in Table (6) showed that cookies which replacement with microwave defatted black rice bran for wheat flour has higher amount of phosphorus, potassium, calcium, iron, and zinc and lower amount of sodium in compared with those of control. The effect of using the microwave defatted black rice bran (either increment or decrement) on minerals contents of cookies increased with increasing its replacement ratio. From the above mentioned data, that used of microwave defatted rice bran in shoring the wheat flour cookies to obtain a satisfied cookies rich in some important minerals such as phosphorus and potassium.

These results are somewhat in agreement with those reported by Sharif *et al*. (2009) Abd El-Galeel. and El-Bana (2012) for cookies supplemented with defatted rice bran.

Table 6. Minerals content of cookies processed with microwave defatted black rice bran flour (mg/100g):

Samples Components	Control WF	MW-DBLRB 5%	MW-DBLRB 10%	MW-DBLRB 15%	MW-DBLRB 20%	MW-DBLRB 25%
Phosphorus (P)	336.10	376.32	417.23	461.12	500.32	539.64
Potassium (K)	40.10	41.01	42.10	42,90	43.70	44.60
Calcium (Ca)	110.50	141.10	170.32	201.43	231.30	263.21
Magnesium (Mg)	105.71	105.60	105.80	105.67	105.90	105.77
Sodium (Na)	320.11	315.15	312.22	310.43	307.66	304.30
Iron (Fe)	3.20	3.80	4.42	5.0	5.62	6.15
Zinc (Zn)	2.12	2.43	2.75	3.01	3.33	3.61

Each value was an average of three determinations.
Values followed by the same letter in row are not significantly different at $p \leq 0.05$.
WF: Wheat flour 72%; MW-DBLRB: Microwave defatted black rice bran.

Organoleptic evaluation of processed cookies from sabilizied:

The effect of replaced microwave defatted black rice flour (MW-DBLRB) on the sensory quality of cookies are summarized in Table (7).There was a significantly ($p<0.05$) difference in score values of color , taste, Odor, texture and over all acceptability between control and all proceed cookies .

Sensory characteristics of samples cookies prepared using MW-DBLRB up to 5% ratio had nearly similar scores in compared with those of control. Using of MW-DBLRB at the concentration of more than 5% led to decrease the scores for sensory characteristics of cookies especially in taste sample which contained 25% MW-DBLRB that recorded 7.40 compared to 9.05 in control.

Lowest overall acceptability of the cookies from mixture containing more than 15% MW-DBLRB was attributed to the panelists this may be attributed to the high content of fiber in defatted black rice bran compared with that of wheat flour (72% extraction). These results are in agreement with the findings of Sudha *et al,*. (2007) who reported that progressive increase in supplementation level of rice bran produced progressively darker cookies.

Sharma and Chauhan (2002) and Younus *et al*., (2011) reported that flavor response decreased with increase in the level of bran cookies at 20% replacement of bran flour with wheat flour imparted a bran flavor to cookie.

Generally, prepared all samples with MW-DBLRB were acceptable for the sensory evaluation.

Color is one of significant factors, which affect acceptability of food products by consumer. It is desired that

cookies should have red golden color. Darkening of cookies is attributed to sugar Caramelization and the Millard reactions between sugars and amino acids (Alobo, 2001) in addition to, anthothyanin in microwave defatted black rice bran. The cookies had sweetish taste and pleasant flavor of even replacement ratio of 15%.

Increase the replacement ratio (20%and 25%) was predominant odor and taste of defatted black rice bran and dry mouth feel. Obtained results were nearly similar to those reported for cookies prepared from defatted rice bran (Sharif *et al*., 2009 and Abd El-Galeel. and El-Bana 2012).

Table 7. Organoleptic characteristics of cookies processed from different replacement ratios of microwave defatted black rice bran flour:

Samples / Parameters	Control (WF)	5%	10%	15%	20%	25%
Color (10)	9.20^{a}	9.10^{a}	9.00^{ab}	8.90^{b}	8.05^{c}	8.10^{c}
Taste (10)	9.05^{a}	9.00^{a}	8.50^{b}	8.50^{b}	7.95^{b}	7.40^{c}
Odor (10)	8.80^{a}	8.60^{ab}	8.50^{b}	8.40^{b}	7.90^{b}	7.70^{c}
Texture (10)	9.05^{a}	8.20^{b}	8.20^{b}	8.20^{b}	7,50^{b}	7.45^{b}
Overall acceptability (10)	9.02^{a}	8.72^{a}	8.55^{b}	8.50^{b}	7.85^{b}	7.66^{c}

Each value was an average of three determinations.
Values followed by the same letter in row are not significantly different at $p \leq 0.05$.
WF: Wheat flour 72% - MW-DBLRB: Microwave defatted black rice bran.

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رجيع الأرز هو عبارة عن الناتج من ضرب الارز الشعير وهو ذو قيمة غذائية كبيرة حيث يحتوى علي البروتينات والكربوهيدرات والمعادن وغيرها من المكونات التى تحمل فوائد صحية عالية . أجريت هذه الدراسة بهدف دراسة القيمة الغذائية لرجيع الأرز الملون من صنف الأرز (الاسود) بعد اجراء عملية تثبيت حراري مختلفة باستخدام الميكروويف وكذلك للاستفادة من دقيق رجيع الأرز الأسود منزوع الدهن المعامل بالميكروويف واستبداله بدقيق القمح استخلاص (٧٢%) لانتاج كوكيز غني بالبروتين والعناصر المعدنية . وتم تقدير التركيب الكيميائي لكل من رجيع الأرز المثبت والغير مثبت لرجيع الارز البني والاسود و محتوي العناصر المعدنية .ارتفعت نسبة البروتين والرماد والألياف الخام فى الكوكيز المصنع بنسبة استبدال ٢٥٪ من رجيع الأرز الأسود منزوع الدهن المعامل بالميكروويف مقارنة مع الكنترول حيث سجلت (١٣.٩٧ و ٣.١٠ و ٤.١٢٪)على التوالي . استخدام رجيع الأرز الأسود منزوع الدهن المعامل بالميكروويف ادت الى زيادة محتوى المعادن فى الكوكيز المصنع. أعطت نتائج اختبارات التقيم الحسي أن استخدام رجيع الأرز الأسود منزوع الدهن المعامل بالميكروويف بنسبة أكثر من ٥٪ إلى خفض الخصائص الحسية الكوكيز خاصة في العينات التي تحتوي على ٢٥٪ رجيع الأرز الأسود منزوع الدهن المعامل بالميكروويف والتي سجلت ٧.٤٠ مقارنة مع ٩.٠٥ في العينة الكنترول .