PARTIAL SUBSTITUTION OF BROKEN RICE WITH RED BEAN FLOUR IN PREPARING CRACKERS

ALI, ZEINAB A.

Crops Technology Department, Food Technology Research Institute, ARC, Giza, Egypt.

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Abstract

The main target of the present investigation is to produce crackers from broken rice flour substituted with high protein source . Four genotypes of dried bean seeds differ in its color (from white to black) were subjected to chemical composition to choose the more acceptable and nutritive ones . The chemical composition showed that the protein content ranged from 20.94 to 24.52%, fat 2.86-3.76%, fiber 4.32-5.80%, ash 3.11-3.87% and carbohydrates 64.20-68.01%. Meanwhile broken rice flour showed 7.80, 0.24, 0.31,0.80 and 90.85% for the above mentioned characteristics. The results showed that bean varieties rich in minerals, i.e. K, Na, Ca, Mg, Zn and Fe which ranged from 130-156, 29-36, 110-205, 40-52, 2.28-2.61 and 7.81-9.72 mg/100g sample, respectively. Meanwhile broken rice resulted in poor source of aforementioned minerals. From these analyses red bean was chosen to substitute some of broken rice in making crackers which was the main target of the present study. Total phenols, anthocyanin and antioxidants activity amounted in 595.45 ug GAE/g, 6.32 mg/100g and 557.88 ug TE/g, respectively. Fractionation of the phenolic compounds by HPLC showed 18 component of which Kaenp3, Catechein, Quercitin and E- vanillic were the main componts 4.45202, 4.3227, 3.13409 and 2.30725 mg/100g sample, respectively. The data of sensory evaluation of produced crackers confirmed successfully that it possible to prepare crackers without any unfavorable change in its sensory characteristics by utilization a formula of 15%red bean blended with 85% broken rice flour. Amino acids content, chemical score, and biological value were increased remarkably using the above maintain formula compared with control. It could be concluded that addition or substitution with red bean flour to broken rice flour improved the produced crackers for its chemical composition, minerals, antioxidants activity, amino acids and biological value. It could be used for the celiac disease patients because of its gluten free.

Keywords: - Biological value - Chemical composition -Minerals– antioxidant

INTRODUCTION

The health benefits of beans have fostered growing interests increasing the consumption of beans as a part of human diets (Leterme, 2002). Increasing global population and a larger proportion is expected for both Africa and Asia by year 2020, there will be the need for increasing food security and protein sources, of which common bean will be playing a vital and substantial role. Furthermore, there is need for additional sources of minerals and vitamins, to achieve improved health of the populace, especially, children and pregnant women . (Pinstrup-Anderson *et al.* 1999). Dry beans have much higher contents of protein (20–22%) and dietary fiber (23–32%) than cereal grains (8–17%) and (3-16%), respectively (Tacer-Caba, *et al.* 2015). The color of the bean coat appears to affect the antioxidant capacity because of this correlates with total phenolic content of the bean. Colored beans (red, brown or black) possess greater antioxidant activity than white beansfurthermore, some of these antioxidant compounds are lost during typical preparation and cooking methods, although significant amounts of antioxidants still remain (Xu, *et al.,2007).*

Bean species showed variations in anthocyanins and antioxidant activities. Generally, bean species consisting of greater anthocyanins exhibited greater antioxidant activity. Darker varieties possessed greater antioxidant activity. This information may be useful in the choice of bean species for genotype improvement, prizing and human consumption (Dzomba *et al.* 2013).

Broken rice is solid at a substantially lower price than whole kernels. although the whole rice kernel price is much higher that of wheat, corn, or oats , the rice flour made from broken rice is competitively priced . With its other unique attributes such as bland taste, attractive white color, hypoallergenicity and ease of digestion rice flour has become attractive in the manufacturing of new cereal food such as snak foods, noodles, infant formula, baked products, etc (ji, *et al.,* 2007).

Blending bean flour with other gluten free cereals such as milled rice to produce some bakes must be considered to treat celiac disease patient. In this respect, Anjum *et.al*., (2007) reported that milled rice has both relatively lower protein and fiber content than any other cereals. Ash, fat and fiber contents ranged from 0.54 to 6.04, 000.73 to 14.65and 0.21 to 8.38% respectively in different milling fractions.

People with celiac disease should consume a diet that is free of gluten, a protein found in many grain products. They must eliminate these products from their diet, which increases the risk for deficiencies in several B-vitamins and other nutrients that typically are found in grains. Beans are a naturally gluten-free food, and it provide many of the vitamins and minerals often found in enriched grain products, including thiamin, riboflavin, folate, iron and fiber. Bean flour may be particularly beneficial to those following gluten-free diets because bean flours can be combined with other gluten-free flours (such as rice or tapioca flour) (Niewinski, 2008)

The objective of the current study is to prepare crackers from different blends of broken rice flour and bean flour for people with celiac disease.

MATERIALS AND METHODS

Materials:

Four genotypes of dry beans (*Phaseolus vulgaris L.*) with different coat color (from white to black) Nebrasca, Diasoal, Diacoal and Matelda from Vegetable Crops Department ,Horticulture Research Institute, Agricultural Research Center, Giza, Egypt. Broken rice was obtain from Rice Milling Company, Dakahlia ,Egypt. All chemical used in the present study were analytical grade and purchased from El Gomhorya company. Egypt.

Methods:-

Dry beans were cleaned from impurities and defective seeds, then washed by tap water and soaked in water (1:4w/v) for 24 hours at room temperature. The soaking water was drained every 2 hours. Then, dried at 45±5ºC in drying oven. The dried beans were milled using hummer mill to obtain fine powder flour and kept in polyethylene bags in deep freezer until using. Broken rice was milled after cleaning using the same mill and sieve and storage condition

Chemical analysis:

Raw materials (beans and broken rice) and the produced materials were subjected to chemically analysis, i.e., crude protein, crude fiber, fat, ash and minerals content according to the method described in (AOAC ,2010).Carbohydrates content were calculated by difference (FAO, 2003).

Determination of Anthocyanin and total phenolic content:-

Anthocyanin was determined according to the method in AOAC (2005).
Meanwhile total phenolic content was demined according to the method described by Zilic *et al.*, (2012).

Determination of antioxidant activity (DPPH).

The free radical scavenging capacity of extracts were determined using the stable DPPH according to Hwang and DoThi (2014).

Fractionation and determination of phenolic compounds using HPLC:

Phenolic compounds of the bean methanolic extract was fractionated using Agilant HPLC (series 100). According to method described by Goupy *et al.,* (1999).

Preparation of crackers:

Crackers were prepared by using broken rice flour as control crackers (100%). From a preliminary study of bean substitution, red bean was more acceptable for memorial evaluation and photochemical compounds. Thus crackers were made from broken rice with substitution levels of red bean by 5, 10, 15 and 20% w/w. The crackers were prepared according to the method of Wade (1988) and the formulas were recorded in Table (1).

Table 1. Ingredients (in g) of different blends of crackers formula.

Samples	Broken Rice flour	Red beans flour	Oil	Salt	Sugar	Baking powder	Turmeric
1 (Control)	100	-	10	4	3	4	2
2	95	5	10	4	3	4	2
3	90	10	10	4	3	4	2
4	85	15	10	4	3	4	2
5	80	20	10	4	3	4	2

Determination of fractionation of Amino acids:-

The produced crackers were subjected to hydrolysis using HCL (6 N) at 110C for 24 hours. The acid was evaporated and the residue was dissolved in buffer (pH 2.2). The soluble amino acids were fractionated and determined using Amino Acid Analyzer (Biochrom 30) according to the method outlined in AOAC (2010).

Chemical score:

Chemical score of essential amino acids (EAA) was relatively calculated according to FAO/ WHO (1990) using the following equation.

Chemical score (%) = EAA in crude protein X 100/EAA of FAO /WHO.

Biological value:

Biological value of the protein was calculated using the following equation according to Eggam *et al.,* (1979)

Biological value(%) as follows = 39.55+8.89x lysine(g/100g protein).

Sensory evaluation of produced crackers:

Produced crackers, were sensory evaluated for taste, color, odor, texture and shape by serving to panel of experienced judges from the staff of Food Tech Res. Institute, Agric. Res center, Giza, Egypt according to the method described by (Watts *et al.,* 1989).

Statistical analysis

Sensory evaluation was subjected to analysis of variance using statistical Analysis System (S.A.S.1996). Differences among means within the samples were tested using Duncon s multiple-range test at the 5% probability level.

RESULTS AND DISCUSSION

Chemical composition and minerals contents of the bean varieties and broken rice flour.

Chemical compositions of the four varieties of beans and broken rice flour are presented in Table (2). The data revealed that the protein content ranged from 20.94 to 24.52%, fat 2.86-3.76%, fiber 4.32-5.80%, ash 3.11-3.87 and carbohydrates 64.20-68.10%. Meanwhile, broken rice contained protein amounted in 7.8%, fat 0.24%, fiber0.31%,ash 0.80% and carbohydrates 90.85%.Form the obtained data ,it could be concluded that the bean varieties contained almost the same amounts of the chemical composition with slight variation. Comparing with broken rice, it could be found that the beans rich in all chemical composition than broken rice except that of total carbohydrates. This means that blending broken rice with bean improves its nutritive value. The same Table (2) revealed that, the minerals content of bean varieties ranged from 130 to156, 29 to 36,110 to 205,40 to 52, 2.28 to 2.61 and 7.81 to 9.72mg/100g sample for K, Na, Ca, Mg, Zn and Fe, respectively. On the contrary, broken rice flour resulted in poor source of Ca, Mg, Zn and Fe, while it's slightly varied in K and Na compared with bean varieties. The minerals content of bean suggested to be a good blend to broken rice to produce a good product with high nutritive value. The obtained data were in the line with those found by Emire and Sudip (2005).

Table 2. Chemical composition and minerals content of raw materials (% on dry wt.).

Raw materials	Protein	Crude fat	Crude fiber	Ash	Total carbohydrates
Nebrasca White bean	20.94	2 .86	4.61	3.58	68.01
Diasoal (Red bean)	22.65	2.89	5.80	3.49	65.17
Diacoal (Brown bean)	24.09	3.43	4.32	3.87	64.29
Matelda (Black bean)	24.52	3.76	4.41	3.11	64.20
Broken rice flour	7.80	0.24	0.31	0.80	90.85

Minerals content (mg/100gm)

Raw materials	Potassium (K)	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)	Iron (Fe)
Nebrasca (White bean)	150	29	110	40	2.28	8.78
(Diasoal) Red bean	154	36	205	42	2.51	7.81
(Diacoal) Brown bean	130	33	130	50	2.61	9.72
(Matelda) Black bean	156	32	140	52	2.46	9.10
Broken rice flour	171.50	23.30	26.40	1.30	1.30.	01.40

Phytochemical compounds

Total phenol, anthocyanin and antioxidants activity are very important nutritive factors which inhibit the dangerous effect of free radical. Results in Table (3) revealed that the chosen bean variety namely Diasoal (red bean) contained total phenol, anthocyanin and antioxidants activity of 595.45 µg GAE/g, 6.32mg/100g and 557.88 µg TE/g, respectively. On the other hand, HPLC fractionation profile of phenolic compounds showed 18 compounds. Of which Kaemp-3-was the main component (4.45mg/100g) followed by Catechein (4.32mg/100g) and Quercetin (3.11mg/100g). The other phenolic fractions ranged in amounts from 0.044mg/100g for P-coumaric to 2.3072 mg/100g of E-vanillic. In this respect, Madhujith *et al.* (2004), Also, Oomah *et al. (*2011) and Hutchins *et al.* (2012) reported that consumption of beans is potentially beneficial for human health, including lowering postprandial glucose and insulin response, preventing obesity, reducing the risk of cardiovascular disease and preventing cancer.

Table 3. Total Anthocyanins, total phenols, contents, antioxidants and HPLC fractionation of phenolic acids of red beans (mg/100gm) (%on dry basis)

Total phenols			Total anthocyanins			DPPH		
595.45 µg GAE/g			6.32 mg/100g			557.88 µg TE/g		
HPLC fractionation of phenolic acids.(mg/100g)								
Kaemp-3-	Catechein	Quercetin	E-vanillic	Hespiridin	Hespirtin	Gallic	Benzoic	Caffeine
4.45202	4.3227	3.13409	2.30725	2.2215	0.31345	0.013983	0.550581	0.67836
Ferulic	P-coumaric	Rutin	Epicatechen	Ferulic	Catechol	Naringin	Rosmarinic	Salicylic
0.38617	0.044158	0.39628	0.97496	0.38617	0.071055	0.58858	0.396286	0.678

GAE = gallic acid equivalent

TE = Trolox equivalent

Sensory characteristics of crackers:-

Sensory characteristics of crackers containing different levels of red bean (chosen after premeniraly testes) are shown in Table (4), the obtained data revealed that non-significant difference was found due to the substitution concerning the color, taste, texture, appearance and overall acceptability up to 15%. It could be confirmed successfully that it is possible to prepare crackers without any unfavorable change in its sensory characteristics by utilization such formula (15%red bean +85% broken rice flour) with high nutritive value compared with the control (100% broken rice flour).

Table 4. Sensory characteristics of different blends crackers formulas.

Sample	Color (20)	Taste (20)	Texture (20)	Appearance (20)	Odor (20)	Overall Acceptability (100)
Control (1)	19.00[a] ±1.05409	18.800[a] ±1.03279	19.300[a] ±0.9486	19.200[a] ± 0.7888	19.200[a] ±0.9189	95.500[a] ±3.86580
(2)	17.500[a] ±1.17851	18.00[ab] ±0.9428	18.800[a] ±1.03279	17.400[b] ±1.074967	18.800[a] ± 1.03279	90.500[ab] ±4.30116
(3)	16.700[a] ±5.4782	17.900[ab] ± 1.44913	18.500[a] ±1.26929	18.300[a] ±1.702938	18.300[ab] ±1.25166	89.700[b] ±7.789594
(4)	18.200[a] ±1.03279	17.600[b] ±1.4298	18.100[a] ±1.4491	18.500[ab] ±1.50923	18.300[a] ±1.44813	90.700[ab] ±5.18652
(5)	18.00[a] ±1.8257	17.500[b] ±1.77951	18.200[a] ±1.98885	17.800[b] ±7.511901	18.00[a] ±2.110832	89.500[b] ± 8.92250
L.S.D.	2.4473	1.2262	1.2503	1.2752	1.2977	5.7058

Where:

1- 100% broken rice flour (control)
2- 95% broken rice + 5% red kidney flour .
3- 90% broken rice +10% red kidney flour.
4- 85% broken rice +15% red kidney flour.
5- 80% broken rice +20% red kidney flour.

-values within the same column, followed by the same letter are not significantly different at 0.05 level.
-values mean of 10reading is followed by +-STD.
-LSD is the least significant difference of the replicate reading

Chemical composition of the produced crackers:-

Chemical composition of control crackers sample and blends are shown In Table (5) revealed that substitution with 15% red bean flour (which was highly accepted) contained highest amount of protein, fat, ash, and fiber in amounts of 11.61,6.85,1.87 and 2.43%, respectively. These value were about 1.42, 1.08,2.2 and 1.08 as that of control (broken rice only). Meanwhile, the control was characterized by high carbohydrates content than the substituted one. Concerning minerals, the substituted crackers resulted high amounts than of control, the increasing in minerals were 41.47,43.53,124.3,135.91, 34.83 and 398.3% for K, Na, Ca, Mg, Zn and Fe, respectively. This means that the produced crackers characterized with high nutritive value. Increasing global population and a large proportion is expected from both Africa and Asia by year 2020.These will be need for increasing food security and protein source of which common bean will be playing a vital and substantial role. Furthermore. these is need for additional source of minerals and vitamins to achieve improved health of the populace especially children and pregnant women (Pinstrup-Anderson *et al.,*1999). Also Madar and Stork (2002) reported that legumes may provide sufficient amounts of minerals to meet the human requirements.

Table 5. Chemical composition of control and the highly substituted sample (HSS) (% on dry

Chemical composition	Protein	Crude fat	Crude fiber	Ash	Total carbohydrates	
Control (100% rice)	8.19	6.34	2.25	0.85	82.37	
HSS	11.61	6.85	2.43	1.87	77.24	
Minerals content (mg/100gm)						
Minerals	Potassium (K)	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)	Iron (Fe)
Control (100% broken rice)	79.05	9.35	25.5	19.55	0.89	0.59
HSS	111.83	13.42	57.2	46.12	1.2	2.94

Amino acid composition, chemical score and biological value of the highly substituted sample of crackers:-

It is well known that the protein quality depends mainly in its essential amino asides pattern. Moreover, this quality depends also on its digestibility, antinutritional factors, amino acids bioavailability and the conditions under which it could be eaten to cover the basal requirements (FAO/WHO, 1989). These for, amino acid composition, chemical score and biological value of highly substituted crackers were determined in comparison with control one (Table 6). The obtained results revealed that (HSS) crackers showed higher amounts of essential amino acids and non essential amino acid ones compared with control. The total essential amino acids was found in the amount of 31.6g/100g protein for (HSS) which was about 1.5 fold as that of control. The (HSS) characterized with high amount of lysine, threonine, valine, isoleucine and histidine more than the control by about 72.7%,119.05 %,34.38%,17.86,105.9%, respectively. Chemical score reflect the amount requirements of the essential amino acids as reported by FAO/WHO (2007) which ranged from 8.19%to 100% and 45.9--135.3% for the control and (HSS). The highest value related to the amount of the essential amino acid. Total non essential amino acids showed a value of 35.4 and 55.49g/100g protein which was increased in (HSS) by about 60%. The increases in essential and non essential amino acid reflect the protein content and quality of beans substitution. Biological value reached to its maximum value (90.22%) for the HSS which was about 1.31 fold as that of control. This means that the bean protein easily digested and utilized.

From the obtained data, it could be concluded that substitution with bean flour improved crackers made from broken rice flour. The improvement included chemical composition, minerals, amino acids, and biological value. Also, suitable for celiac disease patients because of it's gluten free.

Table 6. Amino acids composition of highly substituted sample and control (HSS) crackers

Essential Amino acids	Control 100% broken rice flour	Highly supstituted H.S.S. control	FAO/WHO*	Chemical score (control)	Chemical score H.S.S.	Non essential amino acids	Control 100% broken rice flour	Highly H.S.S. substituted sample
Lysine	3.3	5.7	5.8	56.89	98.27	Glutamic	8.8	13.75
Threonin	2.1	4.6	3.4	61.76	135.29	Aspartic	6.9	16.37
Valin	3.2	4.3	3.5	91.42	122.85	Proline	2.9	3.66
Methionin	1.2	1.5	2.5	48.00	60.00	Alanine	3.3	4.2
Isoleucine	2.8	3.3	2.8	100	117.85	Glycine	2.8	3.98
Leucine	4.8	5.6	6.6	72.70	84.84	Arginine	5.8	7.69
Phenylalanine	3.1	3.8	6.3	49.20	60.31	Histidine	1.7	3.5
Tyrosin	0.5	2.8	6.1	8.19	45.90	serine-	2.3	2.8
Total E.A.A.	21	31.6	-----	------	------	Total Non E.A.A.	34.50	55.95
Biological value%	68.88	90.22						

* FAO/WHO (2007)

REFERENCES

1. Anjum, F.M.; Pasha, I.M.; Anwar, B. and Butt, M.S. 2007. Minereal composition of different rice verities and their milling fraction. Pak.J.Agri.Sci.,44(2):332-336.
2. AOAC. 2010. Official methods of analysis of the Association of official analytical chemists (18 thedn)::Method 37.1.68. 2005., Gaithersburg,Maryland, USA.
3. AOAC. 2005. official Methods of Analysis of the Association of Analytical Chemists .18 th Ed., Published by the Association of Official Analytical Chemists . Arlington , Virginia , 2220 USA.
4. Dzomba, P.; Togarepi, E. and Mupa, M. 2013. Athocyanin Content and antioxidant activities of common bean Species (*PhaseolusVularis L .)*grown in Mashonaland Central , Zimbabwe. African Journal Of Agricultural Research, 8(25):3330-3333.
5. Eggam, B.O.; Villegas, E.M.And Vasal, S.K. 1979. Progress in protein quality of maize. J. Sci. Food Agric., 30: 1148-1153.
6. Emire, A. S. and Sudip, K.R. 2005. Proximate composition and physico-chemical properties of improved dry bean (*Phaseolus vulgaris L.*) varieties grown in Ethiopi.LWT,38: 331–338 .
7. FAO/WHO 1989. Digestibility methods. Determination of Protein digestibility corrected amino acids score Report of the joint FAO/WHO Expert Consultation 4-8 December, Betherda, Md., USA.
8. FAO/WHO 1990. Protein quality evaluation Report of the joint " FAO/WHO Expert Consultation, Food and Nitrition paper 51, Rome, Italy.
9. FAO/WHO 2007. Energy and protein requirements In Geneva, Nutritional Reports Series No.935
10. Food and Agriculture Organization (FAO), 2003. Food energy -method of analysis and conversion factors Food and nutrition paper, 77:12-14.

11. Goupy, p. ; Hugues,M. ; Biovin , p .and Amiot, M.J. 1999. Antioxidant composition and activity of barley (HordeumYulgare) and malt extracts and of isolated phenolic compounds .J. Sci . Food Agri , 79: 1625-1634.
12. Hutchins, A. M., Winham, D. M., and Thompson, S. V. 2012. Phaseolus beans: Impact on glycaemic response and chronic disease risk in human subjects. British Journal of Nutrition, 108, S52–S65.
13. Hwang , E S .and Do Thi, N. 2014. Effects of Extraction and processing Methods on Antioxidants compound Contents and Radical Scavenging Activities of Laver (Porphyratenera). Preventive Nutrition and Food Science .19:40-48.
14. JI, Y.; Zhu, K.;Qian, H. and Zhou, H. 2007. Staling of Cake prepared from rice flour and Sticky rice flour. Food Chem.,104:53-58.
15. Leterme, P. 2002. Recommendations by health organizations for pulse consumption. British Journal of Nutrition, 88: S239–S242.
16. Mader, Z. and Stork, A.H. 2002. New legume sources as therapeutic agents. British Journal of Nutritional, 88(1):5287-5292.
17. Madhujith,T.; Naczk, M. and Shahidi, F. 2004. Antioxidant activity of common beans(*PhaseolusvulgarisL*). Journal of Food Lipids ,11,220-233.
18. Niewinski , M.M. 2008. Advances in celiac disease and gluten-free diet. J. Am Diet Assoc.,108:661-672.
19. Oomah, B. D.; Tiger, N.; Olson, M. and Balasubramanian, P. 2011. Phenolics and antioxidative activities in narrow-leafed lupins (*Lupinusangustifolius L*.). Plant Foods in Human Nutrition, 61(2): 91:97.
20. Pinstrup-Anderson, P.; Pandya-Lorch, R. and Rosegrant, M. W. (1999). World food prospects: Critical issues for the early twenty-first century. 2020Vision. Food policy report (p. 32). Washington, DC: International Food Policy Research Institute.
21. SAS. 1996. Statistical Analysis System for windows. In.S.A.S.stat users guide, version 4.10, release 6.12 SAS Institute Inc.
22. Tacer-Caba, Z.; Nilufer-Erdil, D. and Ai, Y. 2015. Chemical composition of cereals and their products.In P. C. K. Cheung & B. M. Mehta (Eds.).Handbook of food chemistry.http://dx.doi.org/10.1007/978-3-642-41609-5_33-1.
23. Wade, P. (1988).Recipe of biscuits used in investigation Applied Science, 1:102-104. L.T.D.,London,U.K.
24. Watts, B.M.; Yimaki, G.L.; Jeffery, L.E. and Elias, L.G. 1989. Basic sensory methods for food evaluation. .IDRC Ottowa ,Ontario, Canada ,PP.66-78.
25. Xu, B. J. ; Yuan, S. H and Chang, S. K. 2007. Comparative analyses of phenolic composition, antioxidant capacity, and color of cool season legumes and other selected food legumes. Journal of Food Science, 72: S167–177.
26. Zilic, S.; Serpen, A.; Akillioglu, G.; Jankovic, M. and Gokmen, V. 2012. Distributions of phenolic compounds, Yellow Pigments and Oxidative enzymes in wheat grains and their relation to antioxidant capacity of bran and rebranded flour . Journal of cereal Science, 56:652-658.

الاستبدال الجزئى لكسر الأرز بدقيق الفاصوليا الحمراء في إعداد المقرمشات

زينب عباس علي

قسم بحوث تكنولوجيا المحاصيل– معهد بحوث تكنولوجيا الاغذية – مركزالبحوث الزراعية – جيزة – مصر

الهدف الرئيسي من تلك الدراسة هو انتاج مقرمشات Crackers من دقيق كسر الارزالمستبدل بمصدر عالي البروتين وذلك باستخدام بذور من الفاصوليا الجافة مختلفة الالوان من (الابيض– الي الاسود) وقد تم تقدير التركيب الكيميائي لتلك البذور لاختيار واحدة منها تكون أكثر قبولأمن الناحية الحسية والتغذوية ، واتضح من التركيب الكيمائي ان محتوى البروتين تتراوح بين ٢٠,٩٤ – ٢٤,٥٢% ، الدهون من ٢,٨٦ –٣,٧٦% ، الالياف من٤,٣٢ – ٥,٨٠%، الرماد من ٣,١١ – ٣,٨٧% ، الكربوهيدرات من ٦٤,٢٠ –٦٨,٠١ . بينما اتضح من نتائج التركيب الكيميائي لدقيق كسر الارز كانت٠,٨٠% ، ٠,٢٤% ،٠,٣١% ،٠,٨٠ % و ٩٠,٨٥% على التوالى. ايضا أظهرت النتائج أن تلك الأصناف من الفاصوليا الجافة كانت غنية بالمعادن مثل البوتاسيوم – الصوديوم – الكالسيوم – الزنك والحديد والتي تتروواح بين١٣٠–١٥٦ ، ٢٩ –٣٦ ، ١١٠ –٢٠٥ ، ٤٠–٥٢ ، ٢,٢٨ – ٢,٦١ و ٧,٨١–٩,٧٢ ملليجرام/١٠٠ عينة على الترتيب. بينما نتائج دقيق كسر الارز أظهرت إفتقاره في المعادن سابقة الذكر ، ومن تلك النتائج تم اختيارالفاصوليا الحمراء للاستبدال من دقيق كسر الارز في تصنيع المقرمشات ، وهذا هو الهدف الرئيسي لتلك الدراسة . وتم تقدير المركبات الفينولية والانثوثيانين ومضادات الاكسدة وكانت **595.45 µg GAE/g** ، **6.32 mg/100g** و **557.88 µg TE/g** علي الترتيب وقد تم تفريد المركبات الفينولية باستخدام جهاز HPLC وأظهرت النتائج وجود١٨ مركب من المركبات الاساسية ومنها -Kaemp-3 وCatechein و Quercitin وE- vanillic (٤,٤٥ ، ٤,٣٢ ، ٣,١٣ و ٢,٣١مللجرام/١٠٠جرام) على التوالى.

كما أظهرت نتائج التقييم الحسي انه من الممكن إعداد مقرمشات ذات جودة وبدون تغير في الخصائص الحسية باستخدام خليط من (١٥% دقيق فاصوليا الحمراء و٨٥% دقيق كسر الارز). كما حدثت زيادة ملحوظة في الاحماض الامينية لتلك العينة بالمقارنة بعينة الكنترول وعلي هذا يمكن القول إن إضافة اواستبدال جزء من دقيق كسر الارز بدقيق الفاصوليا الحمراء بدقيق أدي إلى تحسن إنتاج المقرمشات من ناحية التركيب الكيميائي و المعادن ومضادات الاكسدة والاحماض الامينية والقيمة البيولوجية، ونظرا لخلوها من الجلوتين فإنها تصلح لمرضي حساسية الجلوتين .