Evaluation of Chemical and Sensory Properties of Children Food Product Fortified with Powder (Red Kidney beans and Brown Rice) Application: Crispy Bread sticks

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Abstract:

This study was conducted to evaluate the potential effect of replacing wheat flour (WF) with different levels of powder red kidney beans (RKBP) and brown rice (BRP) as a source of dietary fiber, minerals and antioxidants, on chemical and sensory properties to the preparation of functional crispy bread sticks.

Therefore, the chemical composition such as dietary fiber, protein and minerals contents were determined. Also, the anti-oxidative properties such as phenolic compounds and flavonoid compounds were also determined. RKBP and BRP were incorporated at the levels of 30 and 60% by replacing the WF in bread sticks formulation.

RKBP has recorded a higher content of protein, fiber and ash 21.28%, 3.33% and 2.24% respectively, than BRP was 10.59%, 2.45% and 1.44% respectively. While BRP showed higher values (2.73% and 79.42%) in fat and carbohydrate respectively, than RKBP (1.34% and 69.8%) respectively.

WF replacement with RKBP has recorded the highest content of protein, ash and fiber, while containing a lower amount of carbohydrates than all samples. Significant increases found in mineral contents of all samples when compared to the control sample (WF).

Crispy bread sticks with 30% BRP showed higher texture, taste, odor and preferable sensory score as compared to control and other samples. The score of all the sensory attributes for treatment products reduced with an increase in the levels of RKBP at (60%). According to the sensory analysis results it can be concluded that RKBP and BRP can be used in crispy bread sticks for up to 60%.

Keywords: composition flour -brown rice powder- red kidney beans powder-High-Performance Liquid Chromatography (HPLC) -chemical and sensory Properties.

Introduction:

Nowadays, child nutrition has a major public health concern, where children is tend to like palatable foods with a high content of fats and sugars and decrease in cereals, fruits, legumes and vegetable consumption, while children need the important nutrients for growth **(Fakhri-Aldeen *et al.*, 2015)**. So, there is a growing interest in incentivizing individuals to eat functional foods containing components that provide health benefits by the dietary requirements **(Haruna *et al.*, 2011).** Food fortification is one of the methods that has been applied increasingly and addressed to all age groups **(WHO, 2006).**

Flour is one of the most suitable for multi-micronutrient incorporation, fortified flours is an important source of bioactive micronutrients which is limiting the risk of several deficiencies and enhancing health benefits **(Cardoso *et al.*, 2019).** Intake of bioactive compounds such as antioxidants, total phenols, flavonoids and flavone helps in the maintenance of health and protection from diseases such as cancer, cardiovascular diseases and many other degenerative diseases (**Sattar *et al.*, 2018**). In recent years, great interest was attributed to "the dry legumes" as a fortification to bread, fortifying wheat flour with legumes might enhance the bioactive protein, legumes can also help to prevent under and malnutrition in low-income countries **(Boukid *et al.*, 2019)**, it has a high nutritional content of carbohydrates, dietary fiber, several vitamins (A and E) and minerals as zinc, they also have a high energy value **(Tharanathan & Mahadedevamma, 2003; and Olanipekun *et al.*, 2015)**. Legumes have the potential to prevent protein energy deficiency and are known as "poor man's meat" because, that rich in protein content (20-50 **%) (Singh *et al.*, 2017)**, legume flour is used as a replacement for high protein foods to help treat protein deficit **(Dzudie & Hardy, 1996).** For example, blending cereal flour with kidney bean flour (high protein flours) can assist to get better the nutritional value of the product and address the problem of protein energy malnutrition that still exists in our communities **(Inyang *et al.*, 2018).**

Red kidney beans (*Phaseolus vulgaris*) are widely known for their fiber, minerals, vitamins and protein contents **(Osorio-Diaz *et al.*, 2003).** Being a good source of cholesterol-lowering fiber, it has a protective effect on cardiovascular diseases, diabetes and other chronic diseases **(Aparicio-Fernandez *et al.*, 2005)**, its high protein content, which is 2-3 times that of cereal grains and also red kidney bean proteins are a superior supply of several essential amino acids especially lysine which is deficient in grains **(Hayat *et al.*,2014).**

As well as cereals are a simple source of protein as required by the Recommended Daily Allowance (RDA) and high content of vitamins and minerals **(Khatkar, 2005).**

Rice (Oryza sativa L.) is one of the most important cereal crops in human nutrition and contributes about 21% of energy intake worldwide **(Meherunmahar *et al.*, 2018)**. Brown rice is high in useful components due to the nutrients and phytochemicals it contains and has anti-cancer, anti-obesity and anti-diabetic properties **(Ito *et al.*, 2005)** and nowadays, cereal-based snacks have gained importance due to their nutritional value and sensory attributes and could be exploited the brown rice in the processing of gluten-free products, breakfast cereals, bakery products and noodles **(Mir *et al.*, 2017).**

Bakery products are consumed worldwide, and they could represent a potential carrier for the delivery of functional ingredients **(Bianchi *et al.*, 2021).** Therefor scientists are interested in their possibility as a functional food since they allow for the replacement of roots, legumes and other components instead of wheat flour. They are an excellent vehicle for fortification and adding value, so you should pay attention to these products and enhance them with cereals and legumes to improve the nutritional value and health of children **(Shere *et al.*, 2018).** Bakery products like bread, biscuits, cakes and crackers they are the most used products for children and adults. Crispy breadsticks are bakery products, and it is a cylindrical shape of bread, commonly eaten due to their practicality, taste, and crunchiness.

Moreover, it's usually consumed before the meal as an appetizer **(Sattar *et al.*, 2018).**

So, the current study was conducted to evaluate the effect of fortification of the crispy bread sticks with different levels of (RKBP) and (BRP) on chemical and nutritional properties, as well as on the consumer preferences for crispy breadsticks. Special assessment of both polyphenol compounds and antioxidant activity will be placed on the (RKBP) and (BRP) which are used to prepare composition flour used for developing food products.

MATERIALS AND METHODS

Materials

Red kidney beans (RKB), brown rice (BR), and the rest ingredients as (yeast, corn oil, sugar) and wheat flour (WF) used in the preparation were obtained from El-Raia hypermarket, Minia Governorate, Egypt. The (WF) was stored immediately in the refrigerator until used in preparing products.

Technological Methods

The red kidney beans and brown rice were washed, it was dried in an oven at 40°C for 2 h and grounded from the modern mill in house to make flour and then the RKB and BR powders were sieved and kept in an airtight container in the refrigerator for further analyzing process. Crispy Bread Sticks was prepared approbate to the way of **(El-Hadidy *et al.*, 2020)** with some modification as shown in Table (1).

Table (1): Formula of crispy bread sticks: -

Samples / Ingredients	(1) 100:00	(2) 70:30	(3) 40:60	(4) 70:30	(5) 40:60	(6) 70:15:15	(7) 70:30:30
WF (g)	250	175	100	175	100	175	100
RKBP (g)	_____	75	150	_____	_____	37.5	75
BRP (g)	_____	_____	_____	75	150	37.5	75
Corn oil (g)	60	60	60	60	60	60	60
Salt (g)	2	2	2	2	2	2	2
Sugar (g)	7	7	7	7	7	7	7
Moist yeast (g)	5	5	5	5	5	5	5
Water (ml)	125	125	125	125	125	125	125

Chemical properties:-

Moisture, ash, fiber, fat and protein contents were determined according to **A.O.A.C. (2012)**. Carbohydrate content was calculated by **(FAO, 1982)** the following equation:

Carbohydrate (%) = 100 – (Fat % + Moisture% + Fiber % + Ash % + Protein).

The Minerals Content:-

The minerals content of raw materials and the prepared samples (calcium, phosphorous, magnesium, iron and zinc) were determined according to the method described in **A.O.A.C. (2012),** using the dry ash method for the preparation of samples. The minerals content were determined by using Atomic Absorption Spectrophotometer (Model 3300, Perkin-Elmer, UK).

- Phosphorus content:-

Phosphorus content (g/100g dry weight) was determined calorimetrically according to the method of **(Jackson, 1958).** The digestive solution (1ml.) was added to a clean test tube, 0.2 ml of ammonium molbidate, 0.2 ml hydroquinone and 0.2 ml sodium sulphite then completed the volume to a fixed volume (10ml). After a 30 min of reaction at room temperature, the absorbance (Abs) of the solution was measured at 660 nm using a Jasco V630 spectrophotometer. Control was prepared by the same procedure without a sample.

-Magnesium, Calcium, Zinc and Iron content.

Elements magnesium, calcium, zinc and iron were determined by using Atomic Absorption Spectrophotometer, Pyeunican SP1900, according to (**Brandifeld and Spincer, 1965)**.

The HPLC analysis method of the phenolic compounds and flavonoids :-

To determine phenolic acids and flavonoids, samples were prepared according to the method described by **(Chandrasekara & Shahidi, 2011).** 1 mg of the sample was placed in a test tube. Weights of samples were extracted with 10 ml methanol in an ultrasonic bath for 45 min. The samples were centrifuged for 7 min at 4200 rpm. The supernatant was filtered through polyamide filter Chromafil AO-45/25 and transferred into a vial prior to analyses.

A high-performance liquid chromatography system equipped with a variable wavelength detector (Agilant technologies, Germany) 1200 series was used. Also, the HPLC was equipped with an autosampler, Quaternary pump, degasser and column compartment set at 35oC. Analyses were performed on a C18 reverse phase (BDS 5 μm, Labio, Czech Republic) packed stainless-steel column (4×250 mm).

HPLC method started with a linear gradient at a flow rate of 1 ml/min with a mobile phase of water / acetic acid (98:2 v/v, solvent A) and methanol / acetonitrile (50:50, v/v, solvent B), starting with 5 % B and increasing B to levels of 30% at 25 min, 40% at 35 min, 52% at 40 min, 70% at 50 min, 100% at 55 min. The initial conditions were re-established by 5 min wash in both solvents. All chromatograms were plotted at 280 nm to estimate phenolic acids and at 330 nm for flavonoids. All components were identified and quantified by comparison of peak areas with external standards.

Evaluation of Sensory Characteristics of Crispy Bread Sticks:-

Sensory evaluation was carried out with 50 panelists including staff members, employees, students and postgraduates of the Faculty of Specific Education, Minia University, Egypt, also students' primary school sensory assessment was achieved. Crispy bread sticks were prepared with composite wheat flour with powders of red kidney beans and brown rice at different concentration (30%, 60% and mix), each panelist was served with 7 randomly coded crispy bread sticks specimen on a round glass dish. Bread sticks panelists were asked to use the 10-point to determine the odor, taste, general admission, texture and color of samples. Some of the children also evaluated the crispy also were evaluated the crispy breadsticks to know their acceptance of the samples. Water between the specimens was given for rinsing.

Statistical Analysis:-

The data were analyzed using a statistical analysis method using the GLM (General Linear Model) software **(SAS, 2003).** Double range tests **(Duncan, 1955)** compared average value.

Result and Discussion

Chemical analyses of (RKBP) and (BRP):-

The results in Table (2) clarified the proximate composition of powder red kidney beans and brown rice. All of these data verified the rise of the nutritional value of RKBP and BRP and are consider perfect sources of protein, ash, fat and fiber and might be successfully used in various food technology applications.

Where's, RKBP has recorded a higher content of protein, fiber and ash 21.28%, 3.33% and 2.24% respectively, while BRP showed higher values than RKBP in fat and carbohydrate 2.73% and 79.42% respectively.

Results agreed with the results presented by **Ratnawati *et al.*, (2019)** who reported that the red kidney bean flour ash, fat, protein and carbohydrate content were 2.7, 1.11, 22.53 and 66.5 respectively. Also, **Stoin *et al.*, (2019)** found the content of (RKBF) from protein, ash and fat are 21.88, 3.28, 1.18, and 4.7 respectively. As well as, **Roy *et al.*, (2020)** confirmed that the chemical composition of red kidney beans flour content is 26.25% protein, 8.38% moisture, 2.4% Fat, 3.27 % ash and 59.7 % carbohydrate. And agree with **Ganesan & Xu, (2017)** who revealed that the chemical composition of red beans content of protein was 22.22% and carbohydrate was 63.89%. And **Kambabazi *et al.*, (2021)** showed red kidney beans content of 21.48% protein, 8.82% moisture, ash and fiber contents were 3.94% and 2.33%, fat 2.58%, carbohydrate 60.86%.

That results was disagree with **Manonmani *et al.*, (2014)** whom reported that red kidney beans flour content protein, crude fiber, ash and carbohydrate was (19.13, 1.33 , 3.50 and 58.33 %) respectively. Also, **Chalid *et al.*, (2021)** showed proximate composition of red kidney beans was content 13.33% protein, 17.48 % moisture 5.11% ash and 1.99% fat.

Table (2): Proximate chemical and minerals content of RKBP and BRP:-

Chemical Composition (100g)	Red Kidney Beans Powder (RKBP)	Brown Rice Powder (BRP)
Moisture (g)	**2.01**	**3.37**
Protein (g)	**21.28**	**10.59**
Fat (g)	**1.34**	**2.73**
Fiber (g)	**3.33**	**2.45**
Ash (g)	**2.24**	**1.44**
Carbohydrates (g)	**69.8**	**79.42**
Fe (mg)	**7.12**	**6.18**
Ca (mg)	**105**	**112**
Zn (mg)	**6.45**	**9.25**
Mg (mg)	**136.29**	**98.84**
P (mg)	**430**	**280**

Data are almost in the same line as result by Islam et al., (2012) who found that the content of fat, ash and carbohydrate was 2.80, 1.77 and 77.31% of brown rice flour (BRF), respectively. Yankah et al., (2020) specified that brown rice carbohydrate content was 77.94 %.

On another hand, the results disagree with Dhillon et al., (2021) who reported that brown rice flour content was 7.99%, 1.17 %, 2.06%, 10.20% and 75.58% of protein, fiber, ash, moisture and carbohydrate respectively. Also, disagree with Zahra & jabeen, (2020) who reported that brown rice is higher in nutritional value than white rice and has a content of fiber, fat, carbohydrate and protein were 3.32%, 1.17%, 49.7% and 4.88% respectively. That difference may be led to different types of brown rice or condition of cultivation and harvest.

Minerals also play a vital role in immune function, like iron is important for cardiovascular health, zinc is required for metabolism and fortifying the immune system, magnesium supports normal nerve function, blood glucose regulation, and the production of protein and energy, phosphorus and calcium are basic minerals for bones and teeth (Noah & Adedeji, 2020 and Yankah et al., 2020).

RKBP was higher content of Fe, Mg and P 7.12 ,136.29 and 430 than BRP was 6.18,98.84 and 280.While BRP was higher content of Ca and Zn 112 and 9.25 than RKBP was 105 and 6.45.

Chemical analyses of WF replaced by different levels of RKBP and BRP: -

The chemical analyses of WF replaced by different levels of (RKBP, BRP and their mixture) are presented in Table (3). Results clarified that WF has recorded the highest content of moisture 3.56% and carbohydrate 79.76%. Protein in WF was 11.21% decreased to 10.84% in brown rice powder (60%). On other hand BRP has a high content of fat than WF. The result agrees with El-Hady et al., (2012) who revealed that brown rice contains protein lower, while containing a higher content of lipids than that wheat flour.

WF replacement with RKBP recorded the highest content of protein, ash and fiber, while containing a lower amount of carbohydrates than all samples.

Table (3): Chemical analyses of WF replaced with different levels of RKBP and BRP:-

Chemical Composition (g /100g)		Moisture	Protein	Fat	Ash	Fiber	Carbohydrates
WF		3.56	11.21	1.62	1.87	1.98	79.76
RKBP	30	3.10	14.23	1.54	1.98	2.39	76.77
	60	2.63	17.25	1.45	2.09	2.79	73.78
BRP	30	3.50	11.02	1.95	1.74	2.12	79.66
	60	3.45	10.84	2.29	1.61	2.26	79.56
Mix RKBP+ BRP	30	3.3	12.63	1.75	1.86	2.26	78.22
	60	3.04	14.05	1.87	1.85	2.53	76.67

The results in Table (4) presented the minerals content of powder RKBP and BRP. Where's, BRP (60%) recorded the higher content of Ca and Zn was 79.38% and 6.10% respectively, while RKBP (60%) showed higher values than all samples in Fe, Mg and P were 4.8 %, 101.62% and 330 % respectively. Result in the same line with **Chaudhary & Sharma, (2013)** who showed that the Fe and P in red kidney beans were 5.3% and 408%. But our results disagree with **Kambabazi *et al.*, (2021)** who found red kidney beans content of 146.4 (Ca) (mg/kg), Zinc was 8.54 (mg/kg) and Iron (Fe) was 21.36 (mg/kg), That difference may be led to a different type of RKB. Also, **Ganesan & Xu, (2017)** reported that the Ca was 167mg, Fe was 7.29 mg and Magnesium was 44 mg in red kidney beans.

Table (4): Minerals content in WF replaced with different levels of RKBP and BRP:-

Chemical Composition (mg /100g)		Fe	Ca	Zn	Mg	P
WF		**1.32**	**29**	**1.38**	**48.7**	**182**
RKBP	**30**	**3.06**	**51.8**	**2.90**	**75.16**	**256.4**
	60	**4.8**	**74.6**	**4.42**	**101.62**	**330.8**
BRP	**30**	**2.78**	**54.19**	**3.74**	**63.73**	**211.4**
	60	**4.24**	**79.38**	**6.10**	**78.76**	**240.8**
Mix RKBP+ BRP	**30**	**2.92**	**53.00**	**3.32**	**69.45**	**233.90**
	60	**4.52**	**76.99**	**5.26**	**90.19**	**285.80**

And our results in Table (4) were inconsistent with **Yankah *et al.*, (2020)** who found that (Zn) was 12.15 mg/100g and calcium (ca) was 16.60 mg/100g in brown rice. And **Ilowefah *et al.*, (2018)** who showed that the Fe, Mg, P, Ca and Zn in Brown rice were 5.9% 19,73%,15.85%,106.30% and 14.24 % respectively. Also, with **El-Rahman *et al.*, (2010)** found the percentage of Mg, Zn, Fe and Ca purport was 79.7, 51.0, 44.0 and 385.0 in brown rice flour respectively.

All minerals in WF were increased when replaced with different level of RKBP, BRP and mixture of theirs**.** That result agreed with **El-Hady *et al.*, (2012)** who reported that calcium and Iron increased, when adding brown rice flour. **Noah & Adedeji, (2020)** reported that increase in all minerals (P, Fe, Mg and Ca), when adding red kidney beans flour. That results were agree with the results of the current study presented in Table (4), were increased (P) from 182 in WF to 330 in (RKBP), Fe was increased from 1.32 in WF to 4.8 in (RKBP). As well as Mg increased from 48.7 WF to 101.62 in (RKBP), Ca increased from 29 WF to 79.38 in (RKBP).

Phenolic compounds by High-Pressure Liquid Chromatography (HPLC):-

Phenolic compounds are known to be responsible for antioxidant activities and scavenging free radicals which include reactive oxygen species (ROS) such as hydrogen pe roxide, nitric oxide and superoxide anion **(Halliwell, 2001)**. Overproduction of these reactive species will result in oxidative stress and an imbalance of the bodily antioxidant defense system **(Mayne, 2003).**

Samples (RKBP) and (BRP) were analyzed by the HPLC method was applied to determination of phenolic acids, flavonoids and phenol compounds. Results in Table (5) confirmed that the BRP recorded the highest values of (vanillic, caffeine, ferulic, ellagic, coumarin and 4-aminobenzoic), where that (BRP) increased ten times in ellagic and more than two times in vanillic and coumarin. caffeine, ferulic and4.aminobenzoic increased in BRP (52%,41% and 6%) On other hand the RKBP recorded the highest values of (pyrogallol, catechein, chlorogenic, p-oh-benzoic , catechol, gallic and caffeic).RKBP were increased ten times in p-oh-benzoic, five times in catechein, three times in catechol, two times in pyrogallol and once times in gallic. caffeic and chlorogenic increased in RKBP (29% and 12%).

The results are shown in table (5) confirm the presence of these compounds, as chlorogenic was recorded 8.43, ferulic acid was 10.58 and gallic acid was recorded at 0. 96%. Results agreed with **Parmar *et al.*, (2017)** found that kidney beans (KB) were observed the presence of Phenolic compounds as (chlorogenic acid, ferulic acid, catechuic acid, p-caumaric acid and gallic acid). The same researchers confirmed that the beans have been darker in color showed high catechin content high, which agrees with current study results, where catechin was recorded at 32.15%. It is the largest amount in the content of phenolic compounds compared to the rest of the compounds. **Madhujith *et al.*, (2004)** reported that colored beans were a major source of phenolic compounds (PCs) when compared with white beans. **Rocchetti *et al.*, (2022)** who were found the phenol compounds in kidney bean for example vanillic acid, ferulic acid and catechin.

Table (5): Phenolic Compounds in RKBP and BRP (mg/100 g):-

Phenolic compounds (100g)	Red Kidney Beans Powder (RKBP)	Brown Rice Powder (BRP)
Pyrogallol	15.11	5.21
Gallic	0.96	0.45
Catechol	21.41	4.90
4.Aminobenzoic	0.78	0.83
Catechein	32.15	5.05
Chlorogenic	8.43	7.51
P-OH-benzoic	6.78	0.60
Caffeic	6.50	5.02
Vanillic	0.94	3.01
Caffeine	5.44	8.28
Ferulic	10.58	14.90
Ellagic	6.40	76.18
Coumarin	1.15	3.29

Phenolic compounds catechein and vanillic in brown rice were content (5.05 and 3.01 %) respectively. Results agree with **Gong *et al.*, (2017)** who reported that catechein were content 2.25-5.33, vanillic 1.39-3.40 in brown rice varieties, on other hand results caffeic and chlorogenic were (5.02 and 7.51 mg /g) respectively, results disagreed with the same searchers who found that caffeic was 0.32-0.73 and chlorogenic 0.63 mg /g. Also, the results disagree with **Tian *et al.*, (2004)** who found the Phenolic compounds of brown rice flour (BRF) content of 0.07 0.07, 0.03, 0.02 and 0.32 (mg/100 g of Flour) in vanillic, chlorogenic, caffeic and ferulic.

Data was the same line as results obtained with **Faid, (2015)** vanillic was 2.31 mg/100g and chlorogenic was 9.33 mg/100g, while that result disagreed with phenolic compounds content of (BRF) which recorded caffeic was 10.13 mg/100g and gallic was

5.81 mg/100g. Also, **Lang *et al.*, (2020)** showed that the phenolic compounds of (BRF) is 2.5 in caffeic, which this result disagrees with data obtained in Table (5).

Sensory evaluation of crispy bread sticks prepared by WF replaced with 30% and 60% RKBP, BRP and mixture: -

Data presented in Tables (6&7) and fig (1) show the sensory properties (color, texture, odor, taste, shape and overall acceptability) of the fortified crispy breadsticks with different levels (30 %- 60%) of red kidney beans and brown rice powder and their mixture. Results showed no significant differences ($P \leq 0.05$) in color and odor of crispy breadsticks replaced with 30% and 60% RKBP, BRP and Mix. BRP (60%) had the highest score while, RKBP (60%) had the lowest score. Crispy breadsticks replaced WF with 60% RKBP and mix 60% had the lowest value in texture. While no significant difference $P \leq 0.05$) between other breadsticks samples in texture. BR (60%) had the highest values of overall acceptability. Results are agreed with **Ukeyima *et al.*, (2019)** who showed that the texture and overall acceptability decreased in the other hand color increased in bread containing different levels of kidney beans flour.

Our results agreed with **Ratnawati *et al.*, *(*2019)** who showed that biscuits supplemented with 25% red kidney beans flour by the panelists for appearance, crispiness taste, texture and overall acceptability were the highest and the most preferred among the samples.

Table (6): olds Sensory evaluation of crispy breadsticks prepared by WF replaced with different levels of RKBP and BRP (30%, 60% and mixture):-

Samples / *Sensory properties*	*Control*	*RKBP*		*BRP*		*MiX*	
		30%	60%	30%	60%	30%	60%
color	9.07±0.89 [a]	8.87±1.09 [ab]	8.27±1.21 [c]	9.23±0.96 [a]	9.3±0.86 [a]	9.1±0.87 [a]	8.43±1.05 [b]
Texture	8.97±0.94 [a]	9.03±0.98 [a]	8.13±1.12 [b]	9.23±1.02 [a]	9.27±0.96 [a]	8.97±1.05 [a]	8.23±1.08 [b]
Odor	9.37±0.87 [a]	8.87±1.06 [ab]	8.5±1.09 [b]	9.2±0.98 [a]	9.27±0.85 [a]	8.83±1.16 [ab]	8.33±1.19 [b]
Taste	9.13±0.88 [a]	8.8±1.11 [a]	8.00±1.15 [b]	9.17±0.86 [a]	9.27±0.77 [a]	8.93±1.09 [a]	7.97±1.05 [b]
Shape	9.23±0. 8 [a]	9.00±1.06 [ab]	8.53±1.15 [b]	9.23±1.02 [a]	9.37 ±0.79 [a]	9.27±0.81 [a]	8.27±1. 21 [c]
Overall acceptability	9.23±0.67 [a]	8.97±0.95 [a]	8.27±0.96 [b]	9.23±0.76 [a]	9.37 ±0.71 [a]	8.93±0.89 [a]	8.07±1.03 [b]

Each value represents the mean of thirty replicates ±SD. Mean values with the different letters in the same column mean significantly different at p=0.05.

On other hand, results obtained by **El-Hady *et al.*, (2012)** and **Islam *et al.*, *(*2012)** show a decrease in texture and color of bread containing different levels of brown rice flour corporate with (0, 5, 10, 15 and 20%), also decreased flavor and appearance due to increase in the level of BRF in ingredients.

For the children, the crispy breadsticks produced by replaced WF with 30% and 60% BRP had the highest score in all sensory Properties especially BRP (30%) followed by RKBP (30%).

All of these data verified the rise of the nutritional value of RKBP and BRP and are considered perfect sources of protein, ash, fat, fiber and might be successfully used in various food technology applications.

Table (7): Children sensory evaluation of breadsticks production: -

Samples / Sensory properties	*Control*	*RKBP*		*BRP*		*MiX*	
		30%	60%	30%	60%	30%	60%
color	9.5±0.51[bc]	9.65±0.57[b]	9.2±1.03[d]	10.00±0.0[a]	9.85±0.36[ab]	9.85±0.36[ab]	9.35±0.85[cd]
Texture	9.6±0.58[a]	9.5±0.59[ab]	8.85±1.16[c]	9.85±0.36[a]	9.6±0.58[a]	9.5±0.74[ab]	9. 5±1.02[b]
Odor	9.7±0.46[ab]	9.55±0.67[b]	9.25±0.98[bc]	9.75±0.70[a]	9.7±0.46[ab]	9.15±0.85[c]	9.2±0.87[bc]
Taste	9.6±0.49[b]	9.4±0.66[bc]	8.8±0.81[e]	9.9±0.3[a]	9.85±0.36[ab]	9.3±0.72[c]	9.05±1.11[d]
Shape	9.65±0.48	9.65±0.57	9.4±0.86	9.85±0.36	9.75±0.54	9.7±0.56	9.4±1.02
Overall acceptability	9.7±0.46[ab]	9.65±0.57[ab]	9.25±1.04[b]	9.95±0.22[a]	9.85±0.36[a]	9.55±0.5[ab]	9.3±1.00[b]

Each value represents the mean of twenty replicates ±SD. Mean values with the different letters in the same column mean significantly different at p=0.05.

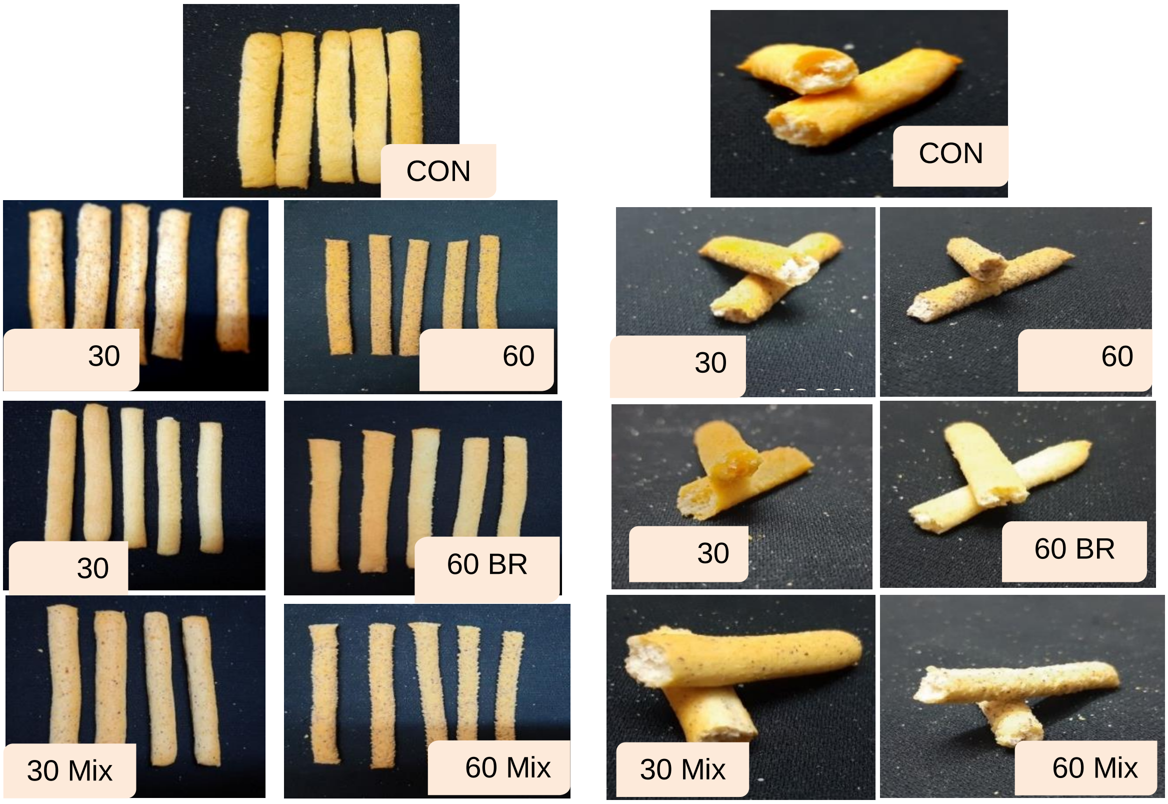

Fig (1): - Crispy Bread Sticks

REFERENCE

A.O.A.C. (2012): Official Methods of Analysis, 19th Ed., Association of Official Analytical Chemists International, Gaithersburg, Maryland; USA.

Aparicio-Fernandez, X.; Yousef, G.; Loarca-Pina, G.; De Mejia, E. and Lila, M. (2005): Characterization of polyphenolics in the seed coat of black jamapa bean (*Phaseolus vulgaris* L.), J. Agric. Food Chem., 53(11):4615–4622.

Bianchi, F.; Lomuscio, E.; Rizzi, C. and Simonato, B. (2021)**:** Predicted Shelf-Life, Thermodynamic Study and Antioxidant Capacity of Breadsticks Fortified with Grape Pomace Powders. Foods, 10 (11): 2815.

Boukid, F.; Zannini, E.; Carini, E. and Vittadini, E. (2019): Pulses for bread fortification: A necessity or a choice?; Trends in Food Science & Technology, 88: 416-428.

Brandifeld, E. and Spincer, D. (1965): Determination of magnesium, calcium, zinc, iron and copper by atomic adsorption spectroscopy. J. Food.Agric. Sci.; 16: 33-38.

Cardoso, R.; Fernandes, Â.; Gonzaléz-Paramás, A.; Barros, L. and Ferreira, I. (2019): Flour fortification for nutritional and health improvement: A review. Food Research International, 125: 108576.

Chalid, S.; Muawanah, A.; Nurbayti, S. and Utami, W. (2021): Characteristics and antioxidant activity of kidney bean (Phaseolus vulgaris L.) tempeh as functional food. AIP Conference Proceedings 2331(1) : 040003(1-7)

Chandrasekara, A. and Shahidi, F. (2011): Determination of antioxidant activity in free and hydrolyzed fractions of millet grains and characterization of their phenolic profiles by HPLC-DAD-ESI-MSn. J. Funct. Foods, 3(3):144–158.

Chaudhary, R. and Sharma, S. (2013): Conventional nutrients and antioxidants in red kidney beans (Phaseolus vulgaris L.): an explorative and product development endeavour. Food science and technology, 14(2): 275-285.

Dhillon, B.; Sodhi, N.; Aneja, E.; Kumar, A. and Jaiswal, S. (2021): Physico-chemical and textural (sensorial and electromyographic) evaluation of cookies formulated using different ratios of brown rice flour and refined wheat flour. Journal of Food Measurement and Characterization, 15(1): 219-227.

Duncan, D. B. (1955): Multiple ranges and multiple F-tests. Biometric, 11(1): 1- 42.

Dzudie, T. and Hardy, J. (1996): Physicochemical and functional properties of flours prepared from common beans and green mung beans. J. Agric. Food Chem., 44(10) : 3029-3032.

El-Hadidy, G. S.; Yousef, E. A. and El-Sattar, A. S. (2020): Effect of fortification breadsticks with milk thistle seeds powder on chemical and nutritional properties. J.Asian Food Sci., 17: 1-9.

El-Hady, A.; Sahar, R. and El-Galeel, A. (2012): The possibility of using ungerminated and germinated brown rice flours at different substitution levels of wheat flour in breadmaking. journal of food and dairy sciences, 3(10): 529-540.

El-Rahman, A.; Soheir, N. and Shehata, W. (2010): Chemical Evaluation Of Blak Rice Comppared With White And Brown Rice. Journal of Food and Dairy Sciences, 1(4): 143-149.

Faid, S. M. (2015): The beneficial effects of brown rice and its bran as natural antioxidants and lowering hyperglycemic in albino rats. Sciences, 5(2): 281-289.

Fakhri-Aldeen, F.; Slman, W. and Abas, W. (2015): Fortification of Some Food Products (Cake) for the Preschool Aged Children. International Journal of Science and Research, 6(8): 1742-1647.

FAO (1982): Food composition tables for the Near East: a research project, FAO Food and Nutrition, Roma.

Ganesan, K. and Xu, B. (2017): Polyphenol-rich dry common beans (Phaseolus vulgaris L.) and their health benefits. International journal of molecular sciences, 18(11): 2331.

Gong, E.; Luo, S.; Li, T.; Liu, C.; Zhang, G.; Chen, J. ; Zeng Z. and Liu, R. (2017): Phytochemical profiles and antioxidant activity of brown rice varieties. Food chemistry, 227: 432-443.

Halliwell, B. (2001): Vitamin C and genomic stability. Mutation Research/Fundamental and Molecular Mechanisms of Mutagenesis, 475(1-2): 29-35.

Haruna, M.; Udobi, C. and Ndife, J. (2011): Effect of added brewers dry grain on the physicochemical, Microbial and sensory quality of wheat bread. American journal of food nutrition,1(1): 39-43.

Hayat, I.; Ahmad, A.; Ahmed, A.; Khalil, S. and Gulfraz, M. (2014): Exploring the potential of red kidney beans (Phaseolus vulgaris L.) to develop protein based product for food applications. Journal of Animal and Plant Sciences, 24(3): 860-868.

Ilowefah, M.; Chinma, C.E.; Bakar, J.; Ghazali, H.M. and Muhammad, K. (2018): Enhancement of Extruded Brown Rice Flour Functionality through Fermentation. Acta Scientific Nutritional Health, 2(10): 2-10.

Inyang, U. E.; Daniel, E.A and Bello, F.A. (2018): Production and Quality Evaluation of Functional Biscuits from Whole Wheat Flour Supplemented with Acha (Fonio) and Kidney Bean Flours. Asian Journal of Agriculture and Food Sciences, 6(6):193-201.

Islam, M.; Taneya, M.; Shams-Ud-Din, M.; Syduzzaman, M. and Hoque, M. (2012): Physicochemical and functional properties of brown rice (Oryza sativa) and wheat (Triticum aestivum) flour and quality of composite biscuit made thereof. The Agriculturists, 10(2):20-28.

Ito, Y.; Shen, M.; Kise, M.; Hayamizu, K.; Yoshino, G.; Yoshi- hara, R. and Yokoyama, J.(2005). Effect of pre-germinated brown rice on postprandial blood glucose and insulin level in subjects with hyperglycemia, J.pn J. Food Chem., 12: 80–84.

Jackson, N.L. (1958): Soil Chemical Analysis. Constable, Ltd. Co., London: 498.

Kambabazi, M.; Okoth, M.; Ngala, S.; Njue, L. and Vasanthakaalam, H. (2021): Evaluation of nutrient content in red kidney beans, amaranth leaves, sweet potato roots and carrots Cultivated in Rwanda. African Journal of Food, Agriculture, Nutrition and Development, 21(4): 17801-17814.

Khatkar, B.S. (2005): Trends in cereal processing. Bev. Food World, 32(11): 65-67.

Lang, G.; Kringel, D.; dos Santos Acunha, T.; Ferreira, C.; Dias, Á.; da Rosa Zavareze, E. and de Oliveira, M. (2020): Cake of brown, black and red rice: Influence of transglutaminase on technological properties, in vitro starch digestibility and phenolic compounds. Food chemistry, 318, 126480.

Madhujith, T.; Naczk, M. and Shahidi, F. (2004): Antioxidant activity of common beans (Phaseolus vulgaris L.). Journal of Food Lipids, 11(3): 220-233.

Manonmani, D.; Bhol, S. and Bosco, S. (2014): Effect of red kidney bean (Phaseolus vulgaris L.) flour on bread quality. Open Access Libr Journal (OALib), 1: 1-6.

Mayne, S. T. (2003): Antioxidant nutrients and chronic disease: use of biomarkers of exposure and oxidative stress status in epidemiologic research. Journal of nutrition, 133(3):933S-940S.

Meherunmahar, M.; Choudhury, R.S.; Hoque, M.M.; Satter, M.A. and Islam, M.F. (2018): Comparison of nutritional and functional properties of BK2 foxtail millet with rice, wheat and maize flour. Progressive Agriculture, 29 (2): 186-194.

Mir, S.A.; Bosco, S.J.; Shah, M.A.; Santhalakshmy, S. and Mir, M.M. (2017): Effect of apple pomace on quality characteristics of brown rice based cracker. J. Saudi Soc. Agri.Sci., 16: 25–32.

Noah, A. A. and Adedeji, M. A. (2020): Quality assessment of cookies produced from wheat and red kidney bean flour. International Journal of Food and Nutritional Sciences, 10:6-9.

Olanipekun, O.T.; Omenna, E.C.; Olapade, O.A.; Suleiman, P. and Omodara, O.G. (2015)**:** Effect of Boiling and Roasting on the Nutrient Composition of Kidney Beans Seed Flour. Sky Journal of Food Science, 4(2): 024-029.

Osorio-Diaz, P.; Bello-Perez, L.; Sayago-Ayerdi, S.; Benitez-Reyes, M.; Tovar, J. and Paredes-Lopez, O. (2003): Effect of processing and storage time on in vitro digestibility and resistant starch content of two bean (Phaseolus vulgaris) varieties. Journal of the Science of Food and Agriculture, 83(12):1283–1288.

Parmar, N.; Singh, N.; Kaur, A. and Thakur, S. (2017): Comparison of color, anti-nutritional factors, minerals, phenolic profile and protein digestibility between hard-to-cook and easy-to-cook grains from different kidney bean (Phaseolus vulgaris) accessions. Journal of Food Science and Technology, 54(4): 1023-1034.

Ratnawati, L.; Desnilasari, D.; Surahman, D. N. and Kumalasari, R. (2019): Evaluation of physicochemical, functional and pasting properties of soybean, mung bean and red kidney bean flour as ingredient in biscuit. IOP Conf. Ser.: Earth Environ. Sci., 251, 012026.

Rocchetti, G.; Gregorio, R.; Lorenzo, J.; Barba, F.; Oliveira, P.; Prieto, M. and Lucini, L. (2022): Functional implications of bound phenolic compounds and phenolics–food interaction: A review. Comprehensive Reviews in Food Science and Food Safety, 21(2), 811-842.

Roy, M.; Sarker, A.; Azad, M.; Shaheb, M. and Hoque, M. (2020): Evaluation of Antioxidant and Antimicrobial Properties of Dark Red Kidney Bean (Phaseolus vulgaris) Protein Hydrolysates. Journal of Food Measurement and Characterization,14 (1):303-313.

SAS (2003): SAS user's Guide: statistics. SAS Institute Cary, NC.

Sattar, D.; Ali, T. ; Abbas, T. and Hasnain, A. (2018): Textural, bioactive and sensory attributes of breadsticks containing germinated and non-germinated legumes. J. Food Chem. Nanotechnol, 4(3): 51-56.

Shere, P. D.; Chaudhari, D. N. and Mali, P. T. (2018): Preparation and characterization of beetroot fortified cheese crackers to enhance nutritional benefits. International Journal of Food Science and Nutrition, 3(1): 52-55.

Singh, B.; Singh, J.; Kaur, A. and Singh, N. (2017): Phenolic composition and antioxidant potential of grain legume seeds: A review. Food Res. Int. 101: 1–16.

Stoin, D.; Petrovich, L.; Velciov, A.; Cozma, A.;Trasca, T.; Rivis, A. and Jianu, C. (2019): Red kidney bean and rice flours: potential ingredients in the production of gluten-free bread with functional quality. Journal of Agroalimentary Processes and Technologies, 25(3): 147-152.

Tharanathan, R. and Mahadevamma, S. (2003): Grain legumes A boon to human nutrition. Trends in Food Science and Technology, 14: 507-518.

Tian, S.; Nakamura, K. and Kayahara, H. (2004): Analysis of phenolic compounds in white rice, brown rice, and germinated brown rice. Journal of agricultural and food chemistry, 52(15): 4808- 4813.

Ukeyima, M. T.; Dendegh, T. A. and Isusu, S. E. (2019): Quality characteristics of bread produced from wheat and white kidney bean composite flour. European Journal of Nutrition and Food Safety, 10(4): 263-272.

WHO (2006): Guidelines on food fortification with micronutrients. Swiss Federal Institute of Technology, Zurich, Switzerland.

Yankah, N.; Intiful, F. and Tette, E. (2020): Comparative study of the nutritional composition of local brown rice, maize (obaatanpa) and millet- A baseline research for varietal complementary feeding. Food Science and Nutrition, 8(6): 2692-2698.

Zahra, N. and Jabeen, S. (2020): Brown rice as useful nutritional source. Pakistan Journal of Agricultural Research, 33(3): 445- 453.

تقييم الخواص الكيميائية والحسية لمنتج غذائي للأطفال مدعم بمسحوق (الفاصوليا الحمراء والأرز البني).

التطبيق: أصابع الخبز المقرمشة

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المستخلص

تم إجراء هذه الدراسة لتقييم التأثير المحتمل لاستبدال دقيق القمح بمستويات مختلفة من مسحوق الفاصوليا الحمراء والأرز البني كمصادر للألياف الغذائية والمعادن ومضادات الأكسدة، على الخصائص الكيميائية والحسية لأصابع الخبز المقرمشة.

لذلك تم تحديد التركيب الكيميائي لمحتوى (الألياف الغذائية، البروتين والمعادن)، كما تم تحديد الخصائص المضادة للأكسدة (المركبات الفينولية والفلافونويد). تم دمج مسحوق الفاصوليا الحمراء والأرز البنى بمستويات 30 و60٪ عن طريق استبدال دقيق القمح في إعداد أصابع الخبز المقرمشة.

اظهرت النتائج ان محتوي مسحوق الفاصوليا الحمراء عالي من البروتين والألياف والرماد (21.28٪، 3.33٪ و2.24٪) مقارنة بمسحوق الأرز البنى (10.59٪، 2.45٪ و1.44٪) على التوالي. اظهرت النتائج ايضا ان مسحوق الأرز البنى سجل قيم اعلي في الدهون والكربوهيدرات (2.73٪ و79.42٪)، مقارنة بـ مسحوق الفاصوليا الحمراء فكانت (1.34٪ و69.8٪). سجل استبدال دقيق القمح بـ مسحوق الفاصوليا الحمراء أعلى محتوى من البروتين والرماد والألياف، بينما يقل المحتوى من الكربوهيدرات مقارنة بجميع العينات. كما اشارت النتائج ان هناك زيادات كبيرة في محتوى المعادن بالعينات عند مقارنتها بعينة الكنترول.

اظهرت نتائج التقييم الحسي ان أصابع الخبز المقرمشة بنسبة 30٪ مسحوق الأرز البنى اكتسب قوامًا وطعمًا ورائحة أعلى ودرجة حسية مفضلة مقارنةً بالعينات الضابطة والعينات الأخرى، بينما انخفضت درجة جميع الخصائص الحسية للمنتجات مع زيادة مستوى مسحوق الفاصوليا الحمراء عند (60٪). وفقًا لنتائج التقييم الحسي يمكن استنتاج أنه يمكن استخدام مسحوق الفاصوليا الحمراء والأرز البني في إعداد أصابع الخبز المقرمشة حتى 60٪.

الكلمات المفتاحية: الدقيق المركب، مسحوق الأرز البني، مسحوق الفاصوليا الحمراء، (HPLC)، الخصائص الكيميائية والحسية.