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Production of Biscuits High Nutritional Value

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ABSTRACT

The aim of investigation to produce high quality, nutritional value, physical and sensory properties biscuits from quinoa flour QF, naked barley flour NBF, carrot powder CP and wheat flour WF. The materials used in this investigation were QF, NBF, CP and WF as well as other ingredients used to produce biscuits. The results of chemical composition of raw materials and biscuit formulas showed that ether extract, ash and crude fiber contents of all formulas prepared using QF, NBF and CP were increased than those of formulas prepared using WF only. The obtained data showed that minerals contents of K, Ca, P and Fe in NBF, QF and CP were higher than those of WF. The blends made from naked barley, quinoa and CP were a rich source of indispensable amino acids. The results showed that biological value BV or Computed protein efficiency ratio C-PER were higher in formulas prepared with NBF, QF and CP (B2, B3, B4 and B5) than those of control (WF). The applied physical procedure using well blended combination of supplements resulted in production of biscuits its excellent sensory properties of taste, color, odor and over acceptability.

***Keywords*:** Quinoa, protein, physical properties, wheat flour.

Introduction

Wheat (*Triticum aestivum*) is a major of the important edible grains around the world (Alu'datt *et al*., 2012). It is used in many forms comprises flat or pan style leavened bread. Wheat flour is that it is depression in essential amino acids, such as lysine and methionine, which minimizes its nutritional value when utilization in foods products (Newman and Newman, 2006).

Quinoa proteins considered one of the better affirmative food component, additionally quinoa is a significant source of minerals, vitamins and significant minerals and has likewise been found to contain compounds such as phytosterols, polyphenols, and flavonoids (Hrusková *et al*., 2007). Quinoa protein consist of a balance amino acid such as higher methionine (0.4-1.0%), lysine (5.1- 6.4%) (Repo-Carrasco *et al*., 2003). Unfortunately, quinoa seeds content of bitter-tasting substances (accepting water-soluble saponins) the out layers of quinoa seed coat, which can have a bitter effect on food, the reason most consumed commercial quinoa seeds, have been operation to remove their coating by water washings and milling so to eliminate antinutritional substances before consumption (Rosero *et al.,* 2013).

Nutritionally, quinoa is a stellar grain and the (WHO) World Health Organization has appraised quinoa as tantamount to milk as it contains significant levels of riboflavin, potassium, B6, thiamin and niacin alongside with zinc, magnesium, manganese and copper (Bhaduri, 2013).

Barley flour is plentiful in phenolic compounds vitamin B complex, minerals, and dietary fiber (beta glucan), which assistance to lower cholesterol by formation to bile acids and expelling them from the body, Barley is one of the rich and inexpensive exporter of plant protein that can be utilized to improve the eating regimen of a huge number of individuals, particularly poor people and low salary workers in most countries (Vasan *et al*., 2017). Barley naked (hull-less) is a rich source of soluble fiber and insoluble fiber, it was demonstrated that the high substance of dietary fiber in grain plays a higher role in the health enhance impact of cereal build products and there is a sturdy association between obesity and chronic diseases and the admission of dietary fiber, the high nutritional health impacts of β-glucans are proposed to decrease plasma cholesterol, decrease glycemic index and boosting the immune (Izydorczyk and Dexter, 2008).The Food and Drug Administration advise consumption of 3 g of β-glucan soluble fiber from barley or oat products every day to get bringing down of low serum cholesterol (Verma and Banerjee, 2010). On the other hand, Mariotti *et al.* (2014) indicted that wheat flour has lower amount of β-glucans contrasted with to barley flour (0.136 and

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2.923 g/100g, respectively). A recent study reported that mixing barley flour with wheat flour at various levels derived from barley had fundamentally improved the nutritional good of bread by expanding its degrees of lysine and methionine (Alu'datt *et al*., 2012).

Carrot (*Daucus carota* L) is one of the higher nutritious root vegetables grown is a worldwide, it is an important source of phytonutrients for example carotenoids, and phenolics besides its appreciable amount of minerals and vitamins (Hansen *et al*, 2003). The main physiological purpose of carotenoids is as a portent of vitamin A. Carotenoids are the main antioxidants in carrots which help to decrease the impact of free radicals, reports have demonstrated that they have inhibitory mutagenesis action thus, contributing to reduce risk of some cancers (Dias, 2012).

Biscuits are the most well-known bakery items consumed almost by all sections of the general public in Egypt, some of the causes for such wide prominence are reduce cost in comparison with other manufactory foods, great nutritional quality and accessibility in various structures, various taste and longer shelf life, bakery products are utilized for incorporation of various nutritionally rich ingredients (Sudha *et al*., 2007). The biscuits quality relies on amount and quality of contents (especially the flour), it was discovered that blending two or more distinct materials help to solve the insufficiency problem of grains as Increases nutritional value by utilized different seed as high nutritive source (Shalini and Sudesh, 2005). The improving nutritional value of a commercially applicable biscuit ought appealing to children and grownup, increase ratio in protein, vitamins, and fibers in biscuit, the sensory and textural quality of biscuit are taken into consideration to improve the quality of biscuit (Miranda *et al*., 2010).

The aim of the present study was to substitute the wheat flour in biscuit by QF quinoa flour, NBF barley flour and CP carrot powder in order to rise nutritional value and to improve sensory attributes of biscuit subsequently to get a high quality product.

Materials and Methods

Materials

Quinoa seeds (*Chenopodium quinoa Willd*.) and Naked barley (*Hordeum vulgare)* variety Giza (G) l30, were get from Agriculture Research Center, Giza, Egypt. Wheat flour (72% extraction), Carrot (*Daucus carota* L) and other materials were purchased from the local market at Kafr El-Sheikh City, Egypt.

Samples preparation

Quinoa seeds were cleaned to remove the unwanted materials such as mud particles, dirt, stone, dust, leaf, etc. and soaked in water for 2h at room temperature to get rid of saponins materials., Quinoa seeds were washed ordinarily with tap water until there was no froth in the washing water to remove saponins after that dried at 50°C for 12 h. The quinoa seeds were ground to fine powder utilizing a commercial electric blender (More Blender plant, Model Type No: MB-355, China) to get entire meal quinoa flour (Rosell *et al*., 2009).

Naked barley grains were cleaned, tempered 15% moisture and milled in (a local mill) to obtain whole barley flour 100% extraction.

Carrot powder, the method inducted by Marvin, (2009) was utilization in preparation of carrot powder. The carrot roots were washed in tap water, peeled and cut into slice. The slices were soaked for 3 min in heated water containing sodium meta bisulphite to inhibit browning and discoloration. The carrot slices were cooled by exposing to air and dried at 50°C for 12 h. The dried carrot slices were ground to fine powder phillips mill (model HL 3294/C Phillips) and packaged in black polythene bags until use.

Preparation of biscuits:

Biscuit samples were prepared according to the standard procedure for semi hard sweet biscuits of Bisco Misr Company, at Cairo city, Egypt as shown in Table1.

Table 1: Formulation and added ingredients for biscuits.

Ingredients	Control1	Blend 2	Blend 3	Blend 4	Blend 5
Wheat flour (WF)	100	75	64	59	54
Naked barley flour (NBF)	-	25	25	25	25
Quinoa flour (QF)	-	-	10	15	20
Carrot powder (CP)	-	-	1	1	1
Butter	15	15	15	15	15
Sugar	30	30	30	30	30
Fresh egg	24	24	24	24	24
Ammonium bicarbonate	0.66	0.66	0.66	0.66	0.66
Sodium bicarbonate	0.33	0.33	0.33	0.33	0.33
Skimmed milk	1	1	1	1	1
Vanilla	0.3	0.3	0.3	0.3	0.3

Chemical analyses

Crude protein (official method no 950.36), ash (official method no 930.22), crude fiber (official method no 950.37) and crude ether extract contents (official method no 935.38) were calculated according to the procedure described in AOAC (2000). Total carbohydrates content was determined by difference (100 - crude protein+ ash+ ether extract), Mineral contents were determined according to AOAC (2000). The energy value (on dry weight basis) was calculated using the Atwater formula as: energy (kcal/100 g) =4× protein (%) + 9× fat (%) + 4 × carbohydrate (%).
The energy value was estimated according to James (1995).

Determination of amino acids:

Amino acids content of formulas of biscuits analyzed in National Research Center, Giza, Egypt, as follows: Samples were subjected to acid hydrolysis using 6N HCL. The hydrolyzate was recovered by removing the acid by evaporation in a rotary evaporator. The resulted amino acids were analyzed using amino acid analyzer (LC 3000 amino acid analyzer, High performance system, a product of LC biochrom Eppdrop, Germany). Flow rate 0.2 ml/min, pressure of buffer from 0 to 2 bars, pressure of reagent to 0-150 bar and reaction temperature 123 ºC. Amino acids were analyzed according to the method described in **AOAC (2005)**.

Determination of tryptophan:

Tryptophan content of samples was determined colorimetrically, in the alkaline hydrolyzate using P-dimethyl-amino-benzaldehyde (DMAB), following the method of Miller, (1967). Tryptophan content was secured by the means of standard curve prepared under the same conditions.

Computed protein efficiency ratio (C-PER):

C-PER was calculated as given by Alsmeyer, *et al*., (1974) following the equation: C-PER = 0.684+0.456(Leucine)-0.047(proline).

Computed Biological value(BV):

Biological value was calculated as described by Farag, *et al*., (1996) according following equation: Computed Biological Value (BV) =49.9+10.53C-PER.

Sensory Characteristics of Biscuits

Sensory evaluation for the texture, odor, taste, color, and overall acceptability were done in order to calculated consumer acceptability. A numerical decadent scale extending from 1 to 20 (1 is very bad and 20 for excellent) was utilized for sensory evaluation. (Smith, 1972).

Color measurements of biscuits samples

The crust color of biscuits was determined depending on the method substantive by Tong *et al*., (2010). The L*, a* and b*values for color were evaluated using a Konica Minolta CR-410 Chroma meter (Konica Minolta, Sensing, INC., Japan).

Physical Characteristics of Biscuits.

The control and the samples were examined for physical parameters like width, length, thickness and spread ratio utilize the following prescription were calculated by the method (Nandeesh *et al*., 2010).

Width and length of biscuits (cm). Thickness of biscuits (cm). Spread ratio = width ⁄ thickness. Weight of biscuits was measured as average of values of four individual biscuits with the help of digital weighing balance. Volume of biscuits was measured using width (W), length (L) and thickness (T) using the following formula: Volume (cm^3) = T x W x L

Hardness of biscuits was measured according to the method of AACC (2002).

Statistical analysis:

The expository information was analyzed using SPSS 16.0 programming. Means and standard deviations were resolved utilizing expressive insights. Examinations between samples were resolved utilizing investigation of single direction fluctuation (ANOVA) and multiple range tests, Statistical significance was defined at $P \leq 0.05$ (SPSS, 2000).

Results and Discussions

Chemical composition of raw materials

The proximate compositions of wheat flour (72% extraction), barley flour, quinoa flour and carrot powder are presented in Table (2). The mean value of wheat flour (72% extraction), recorded 11.60% crude protein,1.05% crude ether extract, 0.50% ash, 0.45% fiber and 86.85% total carbohydrates. These were agreeing with Rizk, (2004) who reported that wheat flour (72% extraction) had 10.81% proteins, 0.50% crude fiber, 0.57% ash, 0.81 % lipids and 87.31% total carbohydrates.

As for barley flour, the results showed 10.92% crude protein, 2.60% crude ether extract, 1.30% ash, 2.54 % crude fiber and 85.18% total carbohydrates. The obtained results were in agreement with Rizk, (2014) who reported that barley flour had 10.29% proteins, 2.44% crude fiber, 1.28% ash, 2.66% ether extract and 83.33% carbohydrates. As for quinoa flour, the obtained results showed 13.13% crude protein, 6.52% ether extract, 4.65% ash, 4.53% fiber and 75.70% total carbohydrates. These results were nearly in agreement with Demir and Kilinc (2017) who reported that QF had 14.45% proteins, 2.82% ash and5.01% lipid. Also. Al Shehry, (2016) stated that QF contain 14.40% protein, 5.04% crude fat, 4.00% crude fiber and 3.46% ash.

As for carrot powder, the results showed that it contains 7.37% crude protein, 1.67% crude ether extract, 6.62% ash, 9.25% crude fiber and 84.34% total carbohydrates. These results were, in general, higher than those obtained by Rizk, (2004) who reported that carrot powder had 6.33% proteins, 6.54 crude fiber, 5.62% ash, 1.62% ether extract and 79.89% carbohydrates.

Table 2: The proximate analysis of raw materials

Materials	Crude Protein	Crude ether extract	Ash	Crude fiber	T.C	Caloric value (kcal/100g)
Wheat flour 72%	11.60^{b} ±0.06	1.05^{d} ±0.03	0.50^{d} ±0.05	0.45^{d} ±0.06	86.85^{a} ±0.20	403.25^{c} ±0.25
Barley flour	10.92^{c} ±0.02	2.60^{b} ±0.05	1.30^{c} ±0.04	2.54^{c} ±0.06	85.18^{b} ±0.08	407.80^{b} ±0.15
Quinoa flour	13.13^{a} ±0.03	6.52^{a} ±0.02	4.65^{b} ±0.04	4.53^{b} ±0.06	75.70^{d} ±0.12	414.00^{a} ±0.06
Carrot powder	7.37^{d} ±0.07	1.67^{c} ±0.04	6.62^{a} ±0.05	9.25^{a} ±0.06	84.34^{c} ±0.10	381.87^{d} ±0.07

- Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).
- Each value was an average of three determinations ± standard deviation.

T C = Total carbohydrates

The obtained results indicate that barley flour, quinoa flour and carrot powder are very rich of ash and crude fiber contents compared with wheat flour. Also, the results reveal that quinoa flour is good source for protein, ash and crude fiber. These results make them very useful to prepare high nutritional value bakery products.

Mineral contents of wheat flour, barley flour, quinoa flour and carrot powder:

Data presented in Table (3) showed mineral content of wheat flour, barley flour, quinoa flour and carrot powder as mg ⁄ 100g sample. The obtained data showed that the mean value of minerals contents of (Ca, K, P and Fe) in barley flour, quinoa flour and carrot powder sample were higher than those of wheat flour 72% extraction. The value of Zn in wheat flour (4.6 mg/100g) is higher than that in barley (2.1 mg/100g) and that in quinoa (3.27 mg⁄100g). The content of Mn in wheat flour (3 mg⁄ 100g) is higher than that in barley (1.5 mg/100g). The values were 16.30, 150, 129.63, 4.60, 1.60 and 3.00mg /g of (Ca, K, P, Zn, Fe and Mn), respectively in wheat flour 72% extraction. These results are in agreement with the results reported by El-Dreny and El-Hadidy (2018).

Results of barley flour were 21.40, 160, 189.20, 2.10, 2.00 and 1.50 mg⁄100g, respectively. The results are in agreement with the results reported by Rizk, (2014). Also the results of quinoa flour were 120.33, 1627, 443.65, 3.27, 5.79 and 3.79 mg⁄100g. These results are in agreement with the results reported by Atef *et al*., (2012). Carrot powder contains 287.33, 2215, 38.00, 6.47, 9.50 and 3.29 mg⁄100g, respectively. The results are in agreement with the results reported by Rizk (2004)

Table 3: Minerals content (mg/100g dry sample) of raw materials

Minerals	Macro elements			Micro elements		
Raw materials	**Ca**	**K**	**P**	**Zn**	**Fe**	**Mn**
Wheat flour 72%	16.30^{d} ±0.30	150^{d} ±0.40	129.63^{c} ±0.95	4.60^{b} ±0.04	1.60^{d} ±0.03	3.00^{c} ±0.02
Naked barley flour	21.40^{c} ±0.50	160^{c} ±0.50	189.20^{b} ±1.20	2.10^{d} ±0.03	2.00^{c} ±0.03	1.50^{d} ±0.03
Quinoa flour	120.33^{b} ±0.03	1627^{b} ±2.30	443.65^{a} ±1.45	3.27^{c} ±0.02	5.79^{b} ±0.04	3.79^{a} ±0.04
Carrot powder	287.33^{a} ±0.80	2215^{a} ±3.33	38.00^{d} ±1.55	6.47^{a} ±0.05	9.50^{a} ±0.06	3.29^{b} ±0.05

- Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).
- Each value was an average of three determinations ± standard deviation.

It could be observed that the iron content of barley flour, quinoa flour and carrot powder is higher than that of wheat flour. The iron is important for the schoolchildren, which mostly needs more iron to avoid the anemia especially in developing countries. The results indicated that the tested materials are good sources for the minerals.

Amino acids profile of biscuits (g/100g of protein)

Data given in Table (4) showed the amino acid composition (g amino acid / 100 g protein) of biscuits made from wheat flour 72%, naked barley, quinoa flour and carrot powder. The obtained results indicated that, the amount of total essential amino acids of biscuits blends contained quinoa flour and carrot powder (blend 3, blend 4 and blend 5) were relatively higher compared to biscuits made from wheat flour 72% ext.) only or with barley flour (control and blend 2) lysine, leucine, tyrosine, threonine and methionine in samples contained quinoa flour and carrot powder were higher than those in control biscuits made from wheat flour. On the other hand, total non-essential amino acids contents were lower in blends prepared with barley flour, quinoa flour and carrot powder compared to control prepared from wheat flour.

Protein quality parameters (Computed protein efficiency ratio C- PER and biological value BV) of biscuits made from barley flour, quinoa flour, carrot powder and wheat were presented in Table (4). The results in this Table showed that the quality of protein parameters were higher in samples prepared with barley flour, quinoa flour and carrot powder (B2, B3, B4 and B5) than those of control (wheat flour).

Table 4: amino acids and protein quality parameters in biscuits

Amino acids (g/100g protein)	Control1	Blend 2	Blend 3	Blend4	Blend 5
Essential amino acids					
Lysine	2.93	2.97	3.35	3.52	3.71
Isoleucine	4.29	3.93	4.00	4.02	4.04
Leucine	4.67	4.90	5.28	5.36	5.48
Phenylalanine	5.46	5.30	5.18	5.03	4.93
Tyrosine	2.13	2.16	2.29	2.23	2.16
Histidine	4.11	3.50	3.39	3.32	3.26
Valine	4.56	4.60	4.55	4.60	4.56
Threonine	2.11	2.28	2.45	2.52	2.60
Methionine	1.33	1.55	1.70	1.77	1.87
Tryptophan	1.17	1.40	1.43	1.45	1.50
Total (EAA)	32.76	32.59	33.62	33.82	34.11
Nonessential amino acids					
Aspartic acid	5.77	5.84	5.65	5.43	5.19
Glutamic acid	30.47	28.88	26.99	26.08	25.18
Serine	6.96	6.13	5.89	5.78	5.69
Proline	12.06	12.63	11.90	11.47	11.04
Glycine	3.80	3.86	3.98	4.21	4.45
Alanine	3.76	3.80	3.79	3.83	3.88
Arginine	2.42	3.02	3.33	3.68	3.94
Total (NEAA)	65.24	63.76	61.53	60.48	59.37
C-PER	2.24	2.32	2.53	2.59	2.66
BV	73.56	74.38	76.57	77.16	77.95

EAA: Essential amino acids. **NEAA:** Nonessential amino acids
C-PER = Computed protein efficiency ratio. **BV** = Biological value

Chemical composition of biscuits (on dry weight)

The chemical composition of biscuits prepared from barley flour, quinoa flour, carrot powder with wheat flour and biscuits prepared from 100% wheat flour (72% extraction) was studied and obtained results are shown in Table (5). It was found that crude protein, ether extract, crude fiber and ash increased in all blends of biscuits compared with biscuits prepared from 100% wheat flour (control 1). On the other hand, the mean value of crude protein decrease in (B2) and (B3) of biscuits made from wheat flour with barley flour and quinoa flour. Also total carbohydrate in all blends of biscuits decrease compared with biscuits prepared from 100% wheat flour. This may be due to barley flour have low amounts of crude protein compared with wheat flour. The results are in accordance with Makpoul and Ibrahem (2015).

Table 5: Chemical composition of biscuits. (on dry weight basis)

Samples	Crude protein %	Ether extract %	Ash %	T. C %	Crude fiber %	Kcal/100 g
Control 1	10.93^{b} ±0.03	12.50^{e} ±0.04	0.66^{e} ± 0.02	75.91^{a} ±0.09	0.30^{e} ±0.03	459.86^{c} ±0.12
Blend 2	10.83^{b} ±0.02	12.77^{c} ±0.07	0.80^{d} ±0.05	75.60^{b} ±0.10	0.66^{d} ±0.02	460.63^{b} ±0.15
Blend 3	10.89^{b} ±0.04	13.13^{b} ±0.03	1.11^{c} ±0.01	74.87^{c} ±0.00	0.97^{c} ±0.01	461.22^{a} ±0.11
Blend 4	10.94^{b} ±0.04	13.31^{a} ±0.06	1.25^{b} ±0.05	74.50^{d} ±0.15	1.11^{b} ±0.01	461.55^{a} ±0.10
Blend 5	11.17^{a} ±0.15	13.39^{a} ±0.09	1.38^{a} ±0.00	74.06^{e} ±0.20	1.24^{a} ±0.02	461.45^{a} ±0.50

- Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).
- Each value was an average of three determinations ± standard deviation.
- T.C = Total carbohydrates - Kcal = Kilo Calories

Sensory evaluation of prepared biscuits

Biscuits replaced by different levels of substitutions of naked barley flour, quinoa flour and carrot powder were sensory evaluated and compared with wheat flour biscuit (control). Table (6) shows that there was a significant increase in the appearance, color, taste, texture, odor and overall acceptability of all biscuits blends (B2, B3, B4 and B5) after incorporating biscuits with naked barley, quinoa flour and carrot powder with wheat flour compared with biscuit made from 100% wheat flour. The sensory attributes of biscuits with 20% quinoa flour (B5) have the best scores than other biscuits samples. Thus, replacement of quinoa flour at 20% level improved the sensory attributes of biscuits. The obtained results accordance with Makpoul and Ibrahem (2015). Since all sensory characteristics had good scores, it could be recommended that biscuits sample contained 25% barley flour, 20% quinoa flour and 1% carrot powder (blend 5) be used in the substitution of wheat flour in the production of high quality biscuits.

Table 6: Organoleptic properties of biscuits

Samples	Appearance 20	Color 20	Texture 20	Odor 20	Taste 20	Overall acceptability 100
Control 1	17.67^{c} ±0.58	16.67^{d} ±0.58	17.66^{b} ±0.58	16.33^{d} ±0.58	17.00^{c} ±0.00	85.33^{e} ±0.03
Blend 2	17.60^{c} ±0.41	17.40^{c} ±0.55	17.60^{b} ±0.54	17.40^{c} ±0.42	17.40^{bc} ±0.55	87.40^{d} ±0.06
Blend 3	18.20^{bc} ±0.27	18.30^{b} ±0.27	18.00^{b} ±0.71	17.80^{bc} ±0.45	18.20^{ab} ±0.27	90.05^{c} ±0.06
Blend 4	18.60^{b} ±0.42	18.80^{ab} ±0.57	18.30^{b} ±0.27	18.10^{ab} ±0.22	18.40^{a} ±0.89	92.20^{b} ±0..10
Blend 5	19.50^{a} ±0.50	19.40^{a} ±0.55	19.20^{a} ±0.27	18.60^{a} ±0.54	19.00^{a} ±0.61	95.70^{a} ±0.05

- Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).
- Each value was an average of ten determinations ± standard deviation.

Color parameters of biscuits

Color is one of the most important quality attributes of bakery products. The Hunter color parameters L (Lightness), a (redness/greenness) and b (yellowness/blueness) are widely used to describe color changes of food materials. Preferred colors are closest to the original color of samples. Color parameters of biscuits made from naked barley flour, quinoa flour and carrot powder were measured and the results were tabulated in Table (7). The results indicated that lightness (L*) value of biscuit sample contained barely flour (B2) was higher but it's a value lower than control. It could be noted that biscuits samples contained barley flour, quinoa flour and carrot powder (B3, B4 and B5) have L values lower but they have a and b values higher than control.

Table 7: Color parameters of biscuits

Blends	L (Lightness)	a (Redness/greenness)	b (Yellowness/blueness)
Control 1	61.43^{b}±.0.03	7.19^{c}±.0.03	36.94^{c}±.0.58
Blend 2	65.98^{a} ±.0.05	5.22^{d} ±.0.05	37.38^{c} ±.0.08
Blend 3	60.39^{c} ±.0.04	9.16^{b} ±.0.01	40.98^{a} ±.0.01
Blend 4	56.25^{e} ±.0.05	7.24^{c} ±.0.02	37.83^{c} ±.0.06
Blend 5	58.85^{d} ±.0.03	9.54^{a} ±.0.04	38.40^{b} ±.0.20

- Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).
- Each value was an average of three determinations ± standard deviation.

Physical properties of biscuits

The results of the physical properties of biscuits prepared from naked barley flour, quinoa flour and carrot powder with wheat flour blends and biscuits made from 100% wheat flour 72% ext. are shown in Table (8). The length, volume and weight were significantly ($P \leq 0.05$) higher in biscuits samples prepared from naked barley flour, quinoa flour and carrot powder (B3, B4 and B5) but width and spread ratio of these samples were lower compared with those of biscuit made from 100% wheat flour. The results in Table (8) show also there was no significant difference in the thickness of the

biscuit samples. It's clear that width, spread ratio, volume and weight of biscuit sample prepared with barley flour without quinoa and carrot powder (B2) were lower than those of control. The results are in agreement with the results reported by Makpoul and Ibrahem (2015). Such differences in the physical properties could be attributed to properties in the raw materials such as naked barley flour, quinoa flour, wheat flour and carrot powder.

Table 8: Physical properties of biscuits

Samples	Length (cm)	Width (cm)	Thickness (cm)	Spread ratio	Weight (g)	Volume (cm^3)
Control 1	8.00^{d} ±0.20	3.00^{a} ±0.20	1.33^{a} ±0.05	2.25^{a} ±0.14	15.00^{d} ±0.30	32.04^{bc} ±3.50
Blend 2	8.93^{c} ±0.12	2.68^{b} ±0.09	1.33^{a} ±0.03	2.02^{b} ±0.03	12.53^{e} ±0.25	31.78^{c} ±1.68
Blend 3	10.23^{a} ±0.06	2.63^{b} ±0.06	1.32^{a} ±0.02	2.00^{b} ±0.05	16.53^{c} ±0.25	35.03^{ab} ±0.89
Blend 4	8.80^{c} ±0.20	2.67^{b} ±0.06	1.33^{a} ±0.01	2.00^{b} ±0.02	17.00^{b} ±0.00	31.21^{c} ±0.88
Blend 5	9.66^{b} ±0.05	2.77^{b} ±0.05	1.33^{a} ±0.03	2.08^{b} ±0.05	18.00^{a} ±0.20	35.60^{a} ±1.05

- Values followed by the same letter in columns are not significantly different at LSD at ($p \leq 0.05$).
-Each value was an average of six determinations ± standard deviation.

Hardness of Biscuits

The importance of texture in the consumer acceptance is highly recognized. Karaoğlu and Kotancilar (2009) showed that hardness is the most important in evaluation of baked goods, because of its close association with human perception of freshness. The data in Figure 1 presented the hardness of biscuits blends and control. The hardness of control biscuits was 95 new tons. On the other hand, all samples become harder with increment quinoa flour level. The results showed that B5 had the highest hardness value 107 newton compared to other samples and control. This may be due to the effect of quinoa flour and naked barley flour in formulation. This might have outcome from combination of protein rich flour or fiber which requirement more water to get good biscuits dough, and the biscuits made from high-absorption dough resort to be highly hard.

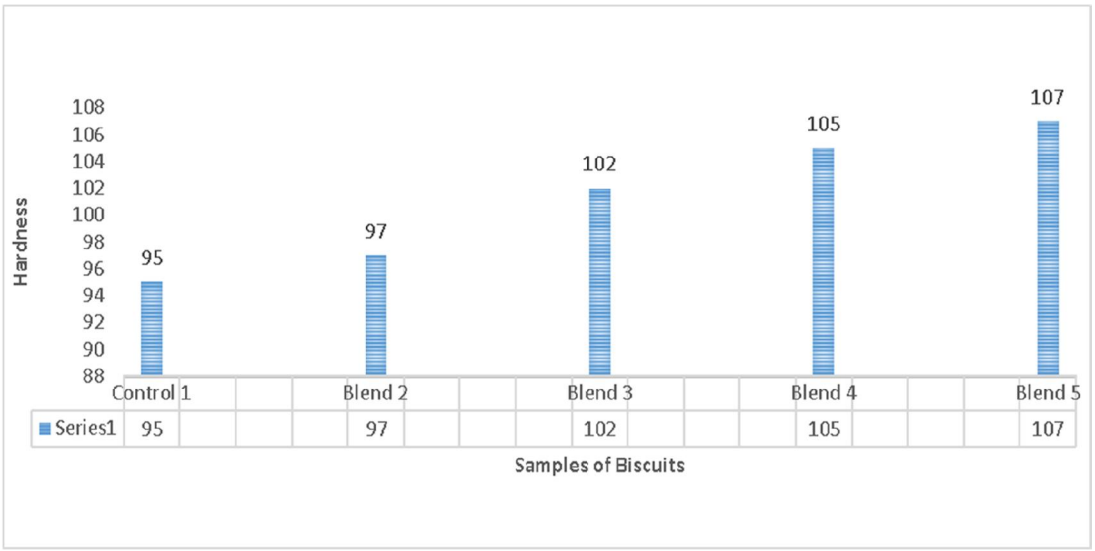


Fig.1: Hardness of prepared biscuits samples

Conclusion

The obtained results in this study revealed that biscuits were prepared using wheat flour supplemented with barley flour, quinoa flour and carrot powder at different levels. The final products

were rich of protein, crude fiber and minerals with high caloric value. These products were a rich source of essential amino acids. Supplemented biscuits had higher energy value with increased energy portions coming from protein, minerals, fiber and amino acids. The applied technological procedure using well blended combination of supplements resulted in production of biscuits its excellent sensory properties of color, taste, odor and over acceptability. Finally, it could prepare some bakery products using materials such as naked barley flour, quinoa flour and carrot powder with high quality that are suitable for consumers.

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