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Using Free Fat Watermelon (*Citrullus Vulgaris*) Seed Kernels in Preparing High Protein Biscuits

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Abstract: Five biscuits formulas containing wheat flour, free fat watermelon (***Citrullus vulgaris***) seed kernels flour in addition to other cereals, rice , corn and chick–pea, were suggested in this study to prepare high protein biscuits. The results indicated that the prepared biscuits containing free fat watermelon seed kernels had a good nutritional and sensory properties compared with that made from 100% wheat flour. The physical properties, thickness, weight index and dimensions of these types of biscuits were differed according to the presence or absence of gluten, source of starch, and protein content. Generally, the panelists accepted the biscuits containing watermelon seed kernels flour particularly coated with chocolate.

INTRODUCTION

Recently more attention has been focused on the utilization of food-processing wastes and by-products, as well as the underutilized agricultural products.The utilization of such materials well help in solving the environmental pollution, reducing the waste treatment and disposal costs, and turning such materials to an economic products. During food manufacturing 50 to 70%of the food raw materials are removed as wastes. Some of these wastes are rich in oil and protein [1- 4].

The seeds of melon fruits are rich in oil and protein [5]. In Nigeria, these seeds used for oil production [6]. Several reports indicated to the high nutritive value of the protein of such seeds [1,7,2]. In some an Arabian countries , the salted roasted watermelon seeds are consumed as a snacks [4].

Biscuit is one of an attractive food products especially for children. Most of the commercial biscuits in the market contain 8-12% protein [8]. This amount is not enough to fulfill the protein requirement of the children.

According to [9] at weaning age, the child requires 20gm protein with 2.1 protein efficiency ratio per day, and at four to six year- old, this value reduces to 13 gm with relatively high chemical score , 80.

In this study, flours of wheat ,water melon seeds in addition to those of cereals, rice, corn, and chick-pea, were mixed in different proportions to prepare high protein biscuits. The proximate composition , nutritional value, physical and organoleptic properties of the produced biscuits were estimated.

MATERIALS AND METHODS

MATERIALS

1- whole watermelon seeds:

The raw seeds of the watermelon (***Citrullus vulgaris***) 2002-2003 crop were obtained from the market in Gaza, Palestine.It was found that seeds composed of 34.8% protein,48.8 % fat and 4.5 % crude fiber.The cleaned dried seeds were manually peeled to remove hulls.

The obtained kernels were first dried in oven at 100°c for 2 hrs. then ground to pass through 60 mesh sieve before oil extraction with diethylether using Soxhlet apparatus for 24 hrs. The defatted flour was desolventized at room temperature (25^0C) for five hrs.then in oven at 60^0C for 2 hrs., re- ground to pass through a 60 mesh sieve, packed in an airtight Kilner jar and kept at 4^0C until used. .

2- Other ingredients:

White milled rice (***Oryza Sativa***)with 7.5 % protein , 0.6 % fat , 0.7 % ash , and 0.6 % fiber, corn ***(Zea maize***) flour with 9.4 % protein , 1.3 % fat , 1.5 % ash and 0.6 % fiber , chick-pea ***(Cicer arietinum)*** grains with 22% protein ,3.2 % fat, 3 % ash and 3.4 % fiber , wheat (***Triticum sp***.) flour of 72% extraction with 11.5 % protein, 1.01 % fat, 0.83 %ash and 0.28 % fiber , casein, vanillin, sucrose, baking powder, anis, whole egg, and corn oil were purshased from Gaza market, Palestine.

METHODS

1. **Technological methods**: The white rice grains were washed , sun dried , and ground to pass through 60 mesh sieve . Also chick- pea grains were cleaned and ground as mentioned above. Table (1) shows the proportion and types of the ingredients used in preparing high protein biscuits. The whole eggs were whipped for 3min. using an electric egg whipper then mixed with other ingredients in the Braun mixer to prepare the suitable dough. The obtained dough was spread on tefal pan at a thickness of 2cm and backed at 210°c for 30-35min. in an electric baking oven to

prepare the Betti bar biscuits. After cooling, the prepared biscuit block was divided into 5x5cm pieces and part of these pieces was coated with chocolate liquor .The biscuits were packed in polystyrene plates . The plates were covered with a transparent polypropylene sheet.

Table (1): The proportions and types of ingredients used for preparing high protein biscuits.

Ingredients (gram)	High protein biscuits (HPB)				
	B1	B2	B3	B4	B5
Defatted watermelon seed flour.	–	50	100	40	40
Wheat flour	100	50	–	–	–
Rice flour	–	–	–	20	40
Balady chick-pea flour	–	–	–	17	17
Corn flour	–	–	–	20	–
Corn oil(ml)	50	50	50	50	50
Casein (free fat)	–	–	–	3	3
Sucrose	50	50	50	50	50
Vanillin	0.1	0.1	0.1	0.1	0.1
Baking powder	7.5	7.5	7.5	7.5	7.5
Anis	3.5	3.5	3.5	3.5	3.5
Egg (whole) number (70gm)	1	1	1	1	1

2- **Physical methods:**

The mean weight of 10 random biscuits was taken as a biscuit index... The average of 10 determinations of thickness of biscuits were measured and reported as a biscuit thickness [10].

3- Chemical methods:

Protein, fats, ash and crude fiber of the suggested high protein biscuit blends were determined according to the official method of [11]. The carbohydrate or nitrogen free extract (NFE) content was calculated by difference.

4- Nutritional methods:

Essential amino acids content of the biscuit blends were determined according to the method of [12] using a Beckman amino acid analyzer (Model 119 c1). The in vitro digestibility was determined by pepsin - pancreatin system according to the procedure of [13]. Computed protein effeciency ratio (C-PER) was calculated by procedure of [14].

Table (2) Organoleptic evaluation sheet of high protein biscuits:

General appearance	Surface and Bottom Characteristics	leavening	Breakness	Texture	Cheweniss	Taste
-Excellent (Uniform without shred, golden color).	-Plane	-Very leaving.	-Crispy (Normal)	-Fine	-Excellent (Crispy, not soft).	-Excellent (pleasant, free from foreign taste)
-Good (golden color).	-Slightly bubbled.	-Leaving	-Moderate (slightly tender).	-Moderate.	-Good (slightly crispy slightly hard)	-Good (pleasant, little floury taste).
-Satisfactory, Brown color.	-Bubbled.	-Slightly leaving.	-Soft.	-Coarse.	-Satisfactory. (nearly crispy, slightly hard).	-Satisfactory. (floury taste).
-Unsatisfactory (dark color).		-Compact.			- Unsatisfactory. (not crispy, soft)	Unsatisfactory (unpleasant foreign taste)

5-Organoleptic properties:

Descriptive sheet test (Table 2) of [15] was used to evaluate the sensory properties of biscuits using ten panelists of Food Industry Department, Al-Azhar University Gaza,Palestine.

6- Statistical analysis:

Means and standard deviation of means were calculated for all data (triplicate determinations) according to the procedure of statistical analysis system as described by [16].

Results and discussion

A- High protein biscuit blends:

1- Proximate composition:

Results in table (3) show the proximate composition of the blends used for preparing the high protein biscuits (HPB) .

Table (3): Proximate composition of high protein biscuits blends :

Constituents (%)	High protein biscuit blends					
	B1 (100% WF)@ Means± SD	**B2** WF : DWMF **1 : 1** Means± SD	**B3** (100% DWMF ©) Means± SD	**B4** DWMF: rice: corn **2 : 1 : 1** Means± SD	**B5** DWMF : rice **1 : 1** Means± SD	**Sign.**
Protein	11.5±0.56a	23.15±0.72b	34.80±0.83c	21.06±0.62b	20.67±0.58b	**
Lipids	1.01±0.06a	1.02±0.05b	1.03±0.05a	1.34±0.07b	1.47±0.08b	*
Crude fiber	0.28±0.03a	2.39±0.11b	4.50±0.21c	2.62±0.13b	2.62±0.15b	**
Ash	0.83±0.06a	2.31±0.21b	3.80±0.29c	2.47±0.18b	2.63±0.16b	**
Carbohydrate	86.38±1.52a	71.13±1.35b	55.87±0.12c	72.51±1.86b	72.61±1.93b	**

@ Wheat flour.

© Free watermelon seed kernels flour.

SD : Standard Deviation **:-**

a & b & c: **Means have the same letter in each line are not significantly different (P≤0.05)**

*** = P ≤ 0.05 ** = P ≤ 0.01**

It can be noticed that from this table:

1- Except the carbohydrate, the other constituents of HPBB[1], 100% wheat flour, were lower than those of other blends.

2- Replacing of wheat flour with 50% and 100% free fat watermelon seed kernels flour as in HPBB$_{2and3}$ increased the protein content from 11.5 to 23.15 and 34.80 %, respectively. This is due to the high concentration of protein in free fat watermelon seed flour . Also, these levels of replacing caused marked increase in crude fiber , ash and slight rise in lipids of biscuit blends.

3- The proximate composition of HPBB^{4and5} free from wheat flour , were nearly similar . This is due to the similarity in the proximate composition between corn and rice flour.

The results showed that N.F.E. level decreased significantly ($P \leq 0.01$) with increasing the level of (DWMF) in biscuits, protein, crude fiber and ash increased gradually and significantly ($P \leq 0.01$) with increasing (DWMF) in biscuits.

2- Nutritional value:

Table (4) shows the results of nutritional value of HPB blends.

It can be noticed that from the data in this table:

1- Except methionine, the other determined essential amino acids of HPBB^{1}, 100% wheat flour were lower than other blends decreased significantly at ($P \leq 0.05$ and 0.01)

2- Replacing wheat flour with 50% or 100% free fat watermelon seed flour increased the determined essential amino acids content except methionine (level decreased significantly ($P \geq 0.05$)) in HPBB^{3or4}. Also, blend 4 and 5 free from wheat flour had nearly the same essential amino acids

3- Comparing with FAO provisional pattern [17], the essential amino acids of HPBB^{1}, 100% wheat flour, were lower except leucine + isoleucine, and Phenylalanine + tyrosine. On the other hand, the blends containing watermelon seed flour and either free or having wheat flour had more essential amino acids compared with those of FAO provisional pattern except methionine in addition to lysine only in HPBB^{2} (1:1 wheat flour and watermelon seed flour) and in HPBB3(100% free fat watermelon seed kernels flour).

4- Generally, the INPDI was varied from 81.5-87.1%. It was increased significantly at ($P \leq 0.05$) only in HPBB^{3}, 100% defatted watermelon seed flour which had the highest protein content (table, 3) than other blends

5- Among the prepared blends , the HPBB$_{1}$ had the lowest C-PER (1.2%). This value increased significantly at ($P \leq 0.05$) after replacing the wheat flour by 50% and 100% free fat watermelon seed kernel flour . The other blends (HPBB^{4and5}) free from wheat flour had 2.20 and 2.48 % C-PER, respectively. These values more than that required ,2.1, in protein used for weaning child [9].

Table (4): Nutritional value of high protein biscuits blends:

Constituents	High protein biscuit blends						
	B1 (100%WF) Means± SD	**B2** WF@:DWMF **1 : 1** Means± SD	**B3** (100% DWMF)© Means± SD	**B4** DWMF:rice:corn **2 : 1 : 1** Means± SD	**B5** DWMF:rice **1 : 1** Means± SD	**Sign.**	**FAO provisional pattern (1973)**
1- Some of essential amino acids(g/16g Nitrogen)							
Leucine + isoleucine	9.06±0.18a	9.42±0.11a	9.96±0.13ab	10.22±0.16b	10.95±0.19ab	*	9.00
Threonine	2.28±0.17a	3.60±0.21b	3.42±0.23b	3.58±0.21b	3.63±0.19b	*	2.80
Valine	2.68±0.11a	4.45±0.09b	4.20±0.09b	4.51±0.10b	4.62±0.11b	**	4.2
Methionine	2.01±0.08a	1.28±0.10b	1.30±0.13b	1.70±0.12c	1.71±0.12c	*	2.2
Phenylalanine +tyrosine	6.67±0.21a	8.68±0.24b	8.98±0.23b	8.80±0.24b	9.00±0.31b	**	5.60
Lysine	1.92±0.06a	4.15±0.07b	3.76±0.07b	4.29±0.08b	4.32±0.08b	**	4.20
2-INPDI[#] (%)	81.5+2.32a	82.73+11a	87.10+2.7b	81.60+2.41a	82.06+2.32a	*	
3- C-PER [$]	1.20+0.08a	1.93+0.04b	2.48+0.1b	2.20+0.07b	2.27+0.09b	**	

@ Wheat flour © Defatted watermelon seed flour.

SD: Standard Deviation :-

a & b: Means have the same letter in each line are not significantly different (P≤0.05)

*** = P ≤ 0.05 ** = P ≤ 0.01**

-In-vitro protein digestibility index (pepsin followed by pancreatin digests).

$ -Computed Protein Efficiency Ratio.

3- Physical and organoleptic properties:

Table (5) shows the physical and organoleptic characteristics of the high protein biscuits .

The data in table (5) revealed that:

1- Comparing with 100% wheat flour biscuits, HPBB[1], the substitution of wheat flour with 50% or 100% watermelon seed flour (HPBB[2]) decreased the thickness and the weight index significantly at (P≤0.01) and (P≤0.05), respectively. The variation may be attributed to the dilution or absence of wheat gluten.

Table (5) Physical and organoleptic characteristics of high protein biscuits free and coated with chocolate.

No. of Product	Type of Product	Biscuits Characteristics								
		Physical properties				Organoleptic characteristics				
		Thick-ness (cm)	Weight Index (gm)	General appearance A B	Surface Bottom Charact-eristics	leavening	Break-ness	Texture	Chew-iness	Taste
$HPBB_1$	**100% wheat flour (WF)@**	3±0.11a	6.7±0.37a	Ex Ex	Plane	Very Leavening	Crispy (normal)	Fine	Excellent Crispy, Not soft	**Ex.**
$HPBB_2$	**WF:DWMF 1 : 1**	1.8±0.07b	6.4±0.35a	Satisfac. Ex	Plane	Leavening	Crispy	Fine	Good	**Good**
$HPBB_3$	**100% DWMF©**	1.7±0.09b	5.6±0.29b	Satisfac. Ex	Slightly Bubbled	Slightly-Bubbled	Soft	Moderate	Satisfactory	**Satisfact**
$HPBB_4$	**DWMF:rice:corn 2 : 1 : 1**	1.6±0.08b	6.1±0.35b	Satisfac. Ex	Slightly Bubbled	Slightly-Bubbled	Slightly tender	Moderate	Satisfactory	**Ex.**
$HPBB_5$	**DJM : rice 1 : 1**	1.6±0.06b	5.7±0.32b	Satisfac. Ex	Slightly bubbled	Slightly-Leavening	Slightly tender	Moderate	Satisfactory	**Good**

SD = Standard Deviation :-

a & b: Means have the same letter in each line are not significantly different ($P \leq 0.05$)

* = $P \leq 0.05$ ** = $P \leq 0.01$

Ex. = Excellent Satisfac. = Satisfactory

2- The biscuit made from 100% watermelon seed flour (HPBB[3]), free from gluten and low in carbohydrates , had the lowest physical characteristics among the other types of biscuits. This is an indication that there is a relation between the physical properties of biscuits and both gluten and starch.

3- The blending of other cereals other than wheat flour, mainly corn and rice, with defatted watermelon seed flour and using such blends in biscuits manufacturing (HPBB[4,5]) led only to increase weight index of biscuits. Again, these results confirmed the importance of starch in improving weight index and gluten to leavening and increasing thickness of biscuit.

The prepared biscuits were subjected for organoleptic evaluation before and after coating with chocolate. The results are tabulated in table (5). It can be noticed from these results that:

1- Generally, the organoleptic properties of the five types of biscuits were accepted by panelists.

2- Among all the prepared biscuits, the panelists described the general appearance of biscuits made from blends containing watermelon seed flour with other cereals , (PHBB[2,3,4,5]) as satisfactory (fairly uniform sides, with small shred). The surface characteristics, leavening, texture, breakness, chewiness and taste of these products were ranged from plane to slightly bubbled, leavening to slightly leavening, fine to moderate, crispy to soft and good to satisfactory taste, respectively. Such variations can be attributed to the ingredients and composition of HPBB especially gluten.

3- Coating the biscuits with chocolate improved only the general appearance of biscuits.

Generally, the above results indicated that free fat watermelon seed flour can be used to prepare high protein biscuit at 40-50% level either with wheat flour or in mixture with other cereal sources, corn and rice and chickpea flours . These products were rich in protein (20-23%) with good nutritional value biscuit made of 100% wheat flour. These results were agree with results of [18] which showed that the biscuits containing 5% glandless cottonseed flour had better organoleptic quality than control.

Also, [19] found that the nutritional value of the biscuits containing 20% cottonseed protein isolate was superior than control. [20], which replaced wheat flour by 40-100% defatted glandless and degossypolized cottonseed flour to prepare nine types of high protein biscuits, found that the panelists preferred the products containing glandless cottonseed flour than glanded degossypolized one and these products were high in protein ,excellent in nutritional value and had a good acceptability compared with that made from 100%wheat flour. Also , they found that thichness , weight index of these types of biscuits were affected according to the presence or absence of gluten, type , source of starch and protein content.

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