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BIOLOGICAL EVALUATION OF COUSCOUS PRODUCED FROM RICE.

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ABSTRACT

This study has investigated that the preparation of couscous free-gluten from white rice (Giza 175) at different levels to treatment celiac disease patients. Chemical composition contents, sensory evaluation and biological evaluation were determined. Couscous was prepared separately form with semolina, rice flour and corn flour and its formulae contained from 75% rice to 25% corn, 50% rice plus 50% corn and 25% rice to 75% corn. This design was used to develop models for the different sensory responses. Adding rice flour at 50% to couscous formula improved of couscous properties compared with corn flour 100%. Thus, adding rice flour at 50% to prepare couscous formula gave the best results than other treatments.

The biological evaluation showed that the rats fed on rice 100% and formula (rice 50%, corn 50%) can be high in grow rats than rats fed on corn and semolina 100%. Feed efficiency and feed efficiency percentage, the results indicated that the negative control, rice 100% and formula (rice 50%, corn 50%) had gave the maximum fed efficiency ratio compared with rats fed on semolina and corn 100%. Rats fed on basal diet (negative control) and (rice 50%, corn 50%) formula gave the highest value in protein efficiency ratio and biological value. This confirms that white rice at 50% is a good source to preparation couscous free-gluten for celiac disease patients.

Keywords: Celiac disease, gluten-free, white Rice, corn flour, couscous, biological value, feed intake, protein intake, protein efficiency ratio, formula.

INTRODUCTION

Durum wheat has been used for a very long time in the manufacture of couscous in the Mediterranean area (Buhler-Miag, 1987). It can be consumed after cooking as fresh couscous or can also be dried for future. However, some people with a specific genetic nature suffer from celiac disease (or non-tropical sprue) upon consumption of food containing wheat, rye or barley (Lai, 2001). The cause of this disease is the ingestion of dietary gluten, which may affect absorption of important nutrients such as iron, folic acid, calcium, and fat-soluble vitamins. The patients have intolerance against the gliadin fraction of wheat and the prolamins of rye (secalins), barley (hordeins) and possibly oats (avidins) (Gallagher et al., 2004). The only effective treatment is a life long gluten free diet (Butterworth et al., 2004; Feighery, 1999; Gallagher et al., 2004; Hamer, 2005). This means that wheat, rye and barley have to be avoided, including durum wheat, spelt wheat, kamut, einkorn and triticate (Taylor et al., 2006). Production of gluten free food is quite low and most of the time it is imported and sold in the market quite expensively. From an economic point of view, it is quite important to increase the variety of gluten free products and with local production it can also be possible to decrease the final cost of these products. Rice is recommended as a safe food for celiac patients since it possesses no gluten and can be used in the production of pasta. Rice supplies important micronutrients, such as iron, zinc, calcium and some vitamins, especially in rural diets (Nesli, 2009). The physical and cooking parameters generally used to assess couscous quality, include color, shape and size uniformity rehydration time, cooked weight, sauce absorption capacity and stickiness. Moth feel (firmness and smoothness) is also considered an important sensory attribute of cooked couscous (Kaup and Walker, 1986). The aim of this work was to prepare couscous from rice and study its biological evaluation.

MATERIALS AND METHODS

Materials

Raw rice variety (Giza 175) was obtained from Rice Breeding Section, Field Crops Research Institute, Agricultural Research Center, Egypt. The other raw materials used were semolina, corn flour and salt obtained from a local market in Giza, A. R. E.

Methods

Determination of chemical composition:

The recommended methods of the Association of Official Analytical Chemists AOAC (1999) were adopted to determine the levels of Crude protein, moisture, ash, oil and crude fiber. Nitrogen content was determined using the Kjeldahl method (Kjeldahl, 1883) and multiplied by a factor 5.95 to determine the crude protein content. Moisture content was determined by drying the samples at 105°C to a constant weight. Ash was determined by the incineration of 1.0 g samples placed in a muffle furnace, maintained at 550°C for 5h. Crude fat was determined by Soxhlet method. Crude fat was obtained by exhaustively extracting 5.0g of each sample in a Soxhlet apparatus using petroleum ether (boiling point 40-60 °C) as the extracted. Crude fiber a known weight of the sample (2g) was mixed with ignited asbestos (0.5g) and sulphuric acid (200 ml, 1.25%, w/v). The mixture was boiled under a reflux condenser for 30min, filtered through a Gooch crucible provided with asbestos mat then thoroughly washed with hot distilled water. The residue and the asbestos were boiled with aqueous sodium hydroxide solution (200ml, 1.25%, w/v) for 30 min., then filtered through a Gooch crucible as described before. The residue was washed with ethyl alcohol and acetone and dried at 110ºC to constant weight. The content of the Gooch crucible was then ignited in an electric muffle at 550ºC to a constant weight. Ash content was determined and subtracted from the weight of treated material to give the fiber content. Total carbohydrates content was estimated according to Montgomry (1961).

Preparation of couscous:

Approximately 80 – 100ml of water (depending on the flour) with 2% salt was added separately to 250g from semolina, rice and corn in a large aluminum pan and thoroughly mixed and rolled by hand until agglomeration of samples particles resulted in couscous granule formation. The couscous then was sieved through a set of two sieves (1,400 and 1,900µm mesh openings) to obtain the dusted granulation. Couscous granules retained on the small sieve (1,400µm) were collected and steamed in a couscous maker (couscoussiere) consisting of a 4 L boiler topped by a steamer. The steamer containing couscous was placed over 2.5L of boiling water and steamed for a

selected period of time. Steamed couscous was spread into a cloth sheet and dried at room temperature for approximately 48hr. After drying, couscous samples were sieved through a 1,700μm mesh opening sieve to remove any large agglomerates formed during the steaming process (Debbouz et al., 1994). Also, the formulae were prepared the same couscous from raw materials and the formulae consists of 75% rice plus 25% corn, mix 50% rice and corn and 25% rice plus corn. The chemical analysis of couscous from raw materials and its formulae were determined.

Organoleptically evaluation of couscous:

Couscous samples were evaluated organoleptically by asked 20 experienced panelist from Food Technology Research Institute (FTRI) according to Amerine et al., (1965). Score sheet of sensory evaluation of couscous contents color, taste, odor, mouth feel, granulation, appearance and total score.

Biological evaluation:

Male albino adult rats (30 animals weighing 86g ± 3) were obtained from the private market, Helwan, Giza, Egypt, then transported to Animal House of Ophthalmology Research Institute, Giza, Egypt.

Rats were housed in individual cages with screen bottoms and fed on basal diet (corn starch 70%, casein 10%, corn seed oil 10%, cellulose 5%, and salt mixture 4% and vitamins mixture 1%) for seven days. After equilibration, rats were weighted and divided into 5 groups (6 animals per each) every one was assigned to one of the fife diet groups (negative control (NC), semolina 100%, corn 100%, rice 100% and (rice 50%, corn 50%)). Total feed consumption was weighted, fresh feed was provided every day, and animals were weighted once a week.

Statistical analysis of data:

Data collected from sensory evaluation of couscous were statistically analyzed according to Fisher, (1970). Least square differences test (LSD) was used to compare significant differences between means of treatments according to Waller and Duncan, (1969). Mean values of data were obtained from triplicate determination. Values expressed are mean ±SD. Significance of differences between

control and treated sample was evaluated using Duncan's multiple range test at 5% level.

RESULTS AND DISCUSSION

Table (1) summarized the chemical composition of corn, rice and semolina. The results show that ash, crude fiber and oil content were increased in corn flour (1.65, 3.32 and 2.51%) compare with rice flour (0.50, 0.58 and 0.55%) and semolina (0.75, 0.94 and 0.84%), respectively. On the other hand, the semolina had contained higher protein (14.10%) compared with corn flour (10.68%) and rice flour (8.92%).

Table (1): Chemical composition of raw materials:

Analysis	Corn flour	Rice flour	Semolina
Moisture	10.11 ± 0.53	11.45 ± 0.60	13.50 ± 0.75
Ash	1.65 ± 0.10	0.50 ± 0.03	0.75 ± 0.04
Protein	10.68 ± 0.56	8.92± 0.50	14.10 ± 0.74
Crude Fiber	3.32 ± 0.18	0.58 ± 0.03	0.94 ± 0.06
Oil	2.51 ± 0.15	0.55 ± 0.03	0.84 ± 0.05
H. C.	81.84 ± 4.55	90.25 ± 4.75	83.37 ± 4.39

Values are mean ± SD, n = 3. . H.C. / Hydrolysable Carbohydrates

Data in table (2) showed that the chemical composition of couscous prepared separately from 100% corn, rice and semolina and its formulae (rice 75%, corn 25%), (rice 50%, corn 50%) and (rice 25%, corn 75%). The highest percentages of ash were in semolina 100% and formula (rice 25%, corn 75%). Corn 100% formula had the highest protein content, while, the lowest percentage were in rice 100% and (rice 75%, corn 25%) formula. Corn 100% and (rice 75%, corn 25%) formula contained the lowest and the highest oil percentages, respectively.

Table (2) : Chemical composition of couscous formulae:

Analysis	100% Corn	100% Rice	100% Semolina	75% Rice 25% corn	50% Rice 50% corn	25% Rice 75% corn
Moisture	14.29 ± 0.79	13.96 ± 0.78	13.10 ± 0.77	13.69 ± 0.81	13.50 ± 0.75	13.29 ± 0.74
Ash	1.54 ± 0.17	1.49 ± 0.08	2.02 ± 0.11	1.47 ± 0.07	1.78 ± 0.09	1.85 ± 0.11
Protein	12.90 ± 0.72	8.50 ± 0.50	11.10 ± 0.65	9.24 ± 0.51	10.21 ± 0.60	10.74 ± 0.63
Crude fiber	1.80 ± 0.09	0.85 ± 0.04	2.59 ± 0.15	1.35 ± 0.07	1.69 ± 0.09	2.10 ± 0.12
Oil	2.08 ± 0.12	2.45 ± 0.14	5.06 ± 0.28	5.34 ± 0.31	3.08 ± 0.18	4.03 ± 0.22
H.C.	81.68 ± 4.54	86.71 ± 4.56	79.23 ± 4.17	82.60 ± 0.46	83.24 ± 4.89	81.28 ± 4.28

Values are mean ± SD, n = 3. H.C. / Hydrolysable Carbohydrates

Results in table (3) showed that the sensory evaluation of couscous (for celiac disease) made from raw materials and its formulae. Couscous samples were evaluated for color, taste, odor, mouth feel, granulation and appearance. Data showed that the maximum total score were found in couscous control (semolina 100%) and the formula supplemented with 50 rice flour followed by corn 100%. The results indicated that the highest color score was observed in control (semolina 100%) being 9.30 followed by the formula supplemented with 50% rice flour which gave a value of 8.50. On the other hand, a highly significant decrease in color was noticed in the couscous made from rice flour 100%, the score value was 6.20 compared with the control (semolina 100%). The taste score was recorded in control (semolina 100%)being 18.90 followed by the formula supplemented with 50% rice flour compared with 25, 75, 100% rice flour being 17.80, 16.70, 16.40 and 15.30, respectively. Meanwhile, the sample made from with 100% rice flour showed a significant decrease in color, taste, mouth feel, granulation, appearance and total score the lowest scores compared with control. The data showed also the formula supplemented with rice flour at

levels 50% the score value was higher compared with corn flour 100% regarding color, taste, odor and total score.

Table (3): Sensory evaluation of couscous from raw materials and its formulae.

Formulae	Color (10)	Taste (20)	Odor (20)	Mouth feel (10)	Granulation (20)	Appearance or stickiness (20)	Total score (100)
Semolina100%	9.30 ±0.49	18.90 ±0.99	19.10 ±1.06	9.30 ±0.52	18.40 ±1.02	19.30± 1.07	94.30 ±4.96
Corn 100%	7.90 ±0.42	15.50 ±0.86	16.70 ±0.88	8.20 ±0.48	18.10 ±1.07	18.70± 1.04	85.10 ±4.73
Rice 100%	6.20 ±0.33	15.30 ±0.90	16.80 ±0.99	6.30 ±0.35	15.00 ±0.79	14.30± 0.79	73.90 ±4.11
Rice 75% Corn 25%	7.60 ±0.42	16.40 ±0.86	16.00 ±0.89	7.10 ±0.37	15.90 ±0.94	16.00± 0.84	73.00 ±4.06
Rice 50% Corn 25%	8.50 ±0.45	17.80 ±0.94	17.30 ±0.91	7.90 ±0.44	17.10 ±0.90	17.60± 0.93	86.20 ±4.54
Rice 25% Corn 75%	7.20 ±0.38	16.70 ±0.98	14.00 ±0.82	7.00 ±0.41	15.80 ±0.88	16.10± 0.89	76.80 ±4.04

Data in table (4) showed that the effects of feeding albino rats for 30 days on different diets contained basal diet negative control (NC), semolina, corn, rice and (rice 50%, corn 50%) couscous formula were fed the four rat groups. All rats significantly increased in their weights but the maximum increasing was found in rats fed on rice 100%, formula (rice 50%, corn50%) and basal diet (NC) followed by rats fed on semolina 100% and corn 100% formula (288.11, 280.00, 288.30, 263.81, 259.31gm, respectively). The rats fed on rice 100% and (rice 50%, corn 50%) can be grown higher than rats fed on corn and semolina 100% because of these diets contained high percentage of hydrolysable carbohydrates.

Table (4): Body weight, feed intake, feed efficiency, protein efficiency and biological value of rats.

Diet	Initial Body weight (g)	Final body weight (g)	Body weight gain (g)	Feed intake	Feed Efficiency ratio (%)	Protein intake	Protein efficiency ratio	Biological value
NC	185.38 ± 9.76	288.30 ± 15.17	92.92 ± 5.16	630.10 ± 33.16	14.70 ± 0.86	63.00 ± 3.71	1.47 ± 0.09	65.38 ± 3.85
Semolina 100%	188.21 ± 11.07	263.81 ± 14.66	75.60 ± 3.98	611.81 ± 32.20	12.40 ± 0.09	61.18 ± 3.22	1.24 ± 0.07	62.96 ± 3.49
Corn 100%	183.82 ± 10.21	259.31 ± 15.25	75.49 ± 4.44	608.32 ± 33.79	12.40 ± 0.65	60.83 ± 3.38	1.24 ± 0.07	62.96 ± 3.31
Rice 100%	189.31 ± 10.51	288.11 ± 15.16	98.80 ± 5.48	622.00 ± 34.56	14.30 ± 0.79	62.20 ± 3.27	1.58 ± 0.09	64.96 ± 3.96
Rice 50% Corn 50%	184.92 ± 10.27	280.00 ± 15.21	95.08 ± 5.78	647.81 ± 34.10	14.70 ± 0.82	64.78 ± 3.60	1.47 ± 0.08	66.85 ± 3.71

N.C. Negative control fed on basal diet.

In the same table feed intake showed that rats fed on rice 100%, (rice 50%, corn 50%) and NC gave the highest body weight gain consumed the highest amount of their diet which reflected on their weight followed by rats fed on semolina100% and corn 100%. Also, feed efficiency ratio percentage the results indicated that the basal diet (NC), rice 100% and (rice 50%, corn 50%) formula had maximum feed efficiency ratio compared with rats fed on semolina 100% and corn 100%. Whereas, the rats feed on couscous made from corn 100% gave the lowest feed efficiency ratio. The protein intake, protein efficiency ratio and biological value, the results are reported in the same table and indicated that rats fed on basal diet (NC) and (rice 50%, corn 50%) formula gave the highest value. Meanwhile, corn 100% formula gave the lowest value.

From the a formation that it could be recommended that the couscous made from 50% corn and rice formula gave the best quality, acceptability, nutrition and biological value.

REFERENCES

AOAC (1999). Official Methods of Analysis (17th ed.), Washington of Official Analytical Chemists.

Amerine , M. A., Panghoron, P.M. and Roessler, E. B.(1965). Principals of Sensory Evaluation on Food. Academic Press –New York.

Buhler, M. (1987). Inc. A new process for the manufacturing of pre-cooked instant products. Buhler-Miag Tech. Bull., Uzwill, Switzerland.

Butterworth, J. R., Banfield, L. M., lqbal, T. H. and Cooper, B. T. (2004). Factors relating to compliance with a gluten free diet in patients with celiac disease: comparison of white Caucasian and South Asian patients. Clinical Nutrition, 23(5), 1127-1134.

Debbouz, A. J. Dick, W. and Donnelly, B. J. (1994). Influence of raw material on couscous quality. Cereal Foods World, 39(4) 231-236.

Feighery, C. (1999). Celiac disease. British Medical Journal, 319, 236-239.

Fisher, R.A. (1970). Statistical Method for Research Workers. Eds. Oliver and Boyed, p.140, Edinburgh.

Gallagher, E. Gormley, T. R. and Arendt, E. K. (2004). Recent advances in the formulation of gluten-free cereal based products. Trends in Food Science and Technology. 15, 143-152.

Hamer, R. J. (2005). Celiac disease: background and biochemical aspects. Biotechnology Acta, 23, 401-408.

Kjeldahl, J. (1883). Determination of protein nitrogen in food products. Encyclopedia of Food Science, 439 – 441.

Kaup, S. M. and Walker, C. E. (1986). Couscous in North Africa. Cereal Foods World, 31, 179.

Lai, H. M. (2001). Effects of rice properties and emulsifiers on the quality of rice pasta. Journal of the Science of Food and Agriculture, 83, 203-216.

Montgomry, R. (1961). Further studies of the phenol sulfuric acid reagent for carbohydrates. Biophs. Acta, 48: 591.

Nesli, S. (2009). Rheological properties of rice pasta dough supplemented with proteins and gums. Food Hydrocolloids, 23, 849 – 855.

Taylor, J. R. N., Schober, T. J. and Bean, S. R. (2006). Novel food and non-food uses for sorghum and millets. Journal of Cereal Science, 44, 252-271.

Waller, W.M. and Duncan, D.B. (1969). A boys role for symmetric multiple composition problem. Am. State Assoc. J., 65:1485.

التقييم البيولوجي للكسكسى المنتج من الأرز

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تهدف هذه الدراسة إلى تحضير كسكسى من الأرز الأبيض (جيزة 175) خالي من الحلوتين يصلح لتغذية مرضى حساسية الحلوتين. قد تم إجراء التحليل الكيميائي للمكونات كذلك تقييم المنتج حيوياً. يحضر الكسكسى بواسطة خلط الماء مع سيمولينا القمح أو دقيق الذرة أو دقيق الأرز. ويتم إضافة دقيق الأرز بنسب مختلفة هي 25، 50، 75، 100٪، وقد وجد أنه عند إضافة دقيق الأرز بنسبة 50٪ إلى الكسكسى يحسن من صفاته الحسية مقارنه بدقيق الذرة 100٪ كذلك يعطي أنتاج أفضل من دقيق الذرة وقد تم إجراء تقييم حسي للكسكسى المنتج من الأرز من خلال تقييم اللون والطعم والرائحة والتحبب والاستدارة. كذلك وجد أن الفئران التي تم تغذيتها على 50٪ أرز يمكنها النمو بصورة مماثلة للمجموعة الضابطة وأفضل من المجموعة التي تم تغذيتها على دقيق الذرة وسيمولينا القمح هذا بالإضافة إلى أن معدل استفادة الفئران من الوجبة المحتوية على الأرز سواء بنسبة 100٪، 50٪ كانت مقاربة أو أعلى من المجموعة الضابطة مقارنة بالمجموعات التي تم تغذيتها على سيمولينا القمح أو دقيق الذرة.