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DEVELOPMENT AND EVALUATION OF NOODLES PREPARED FROM RICE AND WHEAT FLOUR BLENDS

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ABSTRACT

Noodles were prepared by incorporation varying blends (0, 20, 40, 60 and 80%) of rice flour in replacement of wheat flour. Noodle samples were evaluated for their proximate composition, scavenging activity, sensory properties and cooking quality characteristics. The proximate composition of uncooked noodles varied significantly, with increasing rice flour level that replaced wheat flour, gradual decreases in moisture, ash, crude fiber and protein contents in noodle pastes were occurred, their values ranged between 4.02-5.33%; 1.11-5.22%, 0.65-0.82% and 8.51-12.81%, respectively. However, increases in fats, total carbohydrates and energy value were take place ranging between 4.62-8.91 %, 71.11-76.74% and 377.64 - 421.43 kcal/100g, respectively. The antioxidant activity ranged between 22.2% for wheat based noodle (100% wheat flour) to 36.8% for sample containing 80% rice flour as scavenging activity for free radicals. The overall acceptability of wheat-based noodles (WF: RF 100:00) were rated maximum for their sensory preferable attributes. While, in others blended flour noodles, the noodles incorporated with up to 40% rice flour received the same acceptability as wheat-based noodle. The cooking quality characteristics differed significantly in the noodle samples; the cooking time, ranged between 6.5 to 10.3 minutes, it was more in wheat-based noodles than noodles from rice flour. Cooking loss; water absorption percent; cooked weight and swelling index values ranged from 0.1 to 0.6%, 137.1 to 231.6%, 23.74 to 33.24 g/g and 3.20 to 5.38 %, respectively; which revealed that a significant hindered was occurred in the functional paste properties and cooking quality parameters with increasing the level rice flour in noodles. The study indicated that, noodle blends from mixtures of rice and wheat flour revealed that the best preferable sensory characteristics and cooking quality characteristics were observed at blending ratio 40 : 60% rice flour : wheat flour. These findings enhance the utilization of non- traditional flours like rice flour for production noodles with high nutritional value.

Keywords: Noodles, rice flour, wheat flour, cooking quality, sensory evaluation.

INTRODUCTION

Noodles are easy of cooking, handling and low cost for consumers; its preparing from ingredients like; wheat flour, salt, and water. Noodles are one of the most consumed foods all over the world. With health concerns, many research concerning about functional foods, like, functional noodles supplemented with spirulina, banana flour and rice flour according to literatures by **Prabhasankar et al (2009); Choo and Aziz (2010); Ishfaq et al (2015)**.

Rice (*Oryza Sativa*) is the most consumed food in Asian countries; and more healthy than other starchy food; rice flour is a suitable ingredient to present gluten-free foods due to its sensory and reduced allergenic characteristics. Noodles based on rice flour get by wet milling are a favored food in Asia **Osella et al (2014)**.

Rice noodles are a popular noodles with highly recommend for low protein diet for kidney patient, the development of low protein diets has become important; for that reason, rice flour noodles compared to preexisting low-protein products appropriate as a basic raw materials in low protein diet **Metzger et al (2018)**.

In this study, rice flour was selected for noodles preparation because of its good nutritional properties; for this reason, the aim was to utilization the rice flour to preparing functional noodle and assessment its incorporation in chemical, cooking and sensory of rice based noodles.

MATERIALS AND METHODS

Materials

Wheat and rice grains were received from Crop Research Institute, Agricultural Research Center, Ministry of Agriculture, Giza, Egypt. The wheat and rice were milled to flour in a grinder and passed through 80-mesh screen. Wheat and rice flours were kept in sealed containers, at 4°C until analysis. Methanol was bought from El-Gomhoreya Co., Cairo, Egypt. Also, 2,2-diphenyl-2-picrylhydrazyl radical (DPPH) were purchased from Sigma–Aldrich Inc. (St Louis, MO, USA).

Methods

Preparation of noodles

The control noodle formula consisted of 100 g of wheat flour, 40 ml of water and 0.5 g of salt. Four additional noodle samples were prepared by substituting wheat flour with 20, 40, 60 and 80 % rice flour. The different formulations were processed into noodles; the prepared dough was placed to rest in a plastic bag for 30 minutes. The dough was passed through a small noodle hand machine for several times with the rollers gap gradually reduced, the noodle strands were cut with a sharp knife to the appropriate length (12 cm). After cutting, the noodle strands were dried at 50 °C according to **Nermin, (2013)**.

Proximate analysis of noodles

The noodles incorporated with rice flour at different ratios were analyzed for their contents of moisture, ash, crude fiber, protein (N x 5.75), fat, and carbohydrate calculated by difference according to the methods described in **AOAC, (2012)**. Meanwhile, the energy value was calculated based on their content of crude protein, fat and available carbohydrate using the formula as follows: Energy value (kcal/100 gm) = (Crude protein × 4) + (carbohydrate × 4) + (Crude fat × 9) as described in **AOAC, (2012).**

Determination of scavenging activity for noodles

The ability of the different blending of noodles extracts to scavenging DPPH free radicals was determined by the method described by **Brand-Williams et al (1995)**. The percentage of scavenging effect was calculated from the decreased in absorbance against control according to the following equation:

$$\textit{Scavenging activity \%} = [(Abs_{control} - Abs_{sample})/Abs_{control}] \times 100$$

Sensory evaluation of noodles

Ten members semi trained panelists from the staff of Food Science Department Ain Shams University were asked to score all cooked noodle samples for their taste, odor, color, chewiness and overall acceptability; using nine-point hedonic scales, where 9 = extremely like and 1 = extremely dislike. Each panelist evaluated five samples (identified by unique three-digit codes) in a balanced sequential order. The optimal ratio of rice flour to wheat flour in the noodles was investigated using sensory qualities in comparison to the control noodles; using a report sheet according to **Watts et al (1989).**

Cooking quality of noodles

Cooking Time

Cooking time was evaluated by observing the time of disappearance of the core of the noodles strand during cooking (every 30 s) noodle samples were squeezed between glass slides to transparent **Ritthiruangdej et al (2011)**.

Cooking Loss

The cooking loss, defined as the amount of solid substances lost into the cooking water, it was determined as depicted in AACC-approved method 66–50.01 **AACC, (2000)**. A 10-g sample of noodles were placed into 500 ml of boiling distilled water and cooked. The cooked noodles were rinsed using 50 ml of distilled water. The cooking water and rinsing water were collected in a beaker and placed into an air oven at 105°C until dry. The residue was weighed and reported as a percentage of the starting material.

Swelling index

The swelling index of cooked noodles was estimated as depicted in AACC-approved method 66–50.01 **AACC, (2000)** and calculated as follows:

Swelling index (%) =

$$\frac{\text{(Weight of the cooked noodles) - (Weight of noodles after drying)}}{\text{(Weight of noodles after drying)}}$$

Water absorption

Water absorption was determined according to the AACC-approved method 66–50.01 **AACC, (2000).** Ten grams of dried noodle samples were pre-weighed and boiled in 300mL of water for the cooking time which previously determined. Then, Noodles were removed and weighed, the weight difference before and after cooking was used to calculate the water absorption as follows:

Water absorption (%)=

$$\frac{\text{Weight of cooked noodles - Weight of raw noodles}}{\text{Weight of raw noodles}} x100$$

Cooked weight

Noodles (10g) were cooked in 300ml of distilled water in a beaker to their optimum cooking time, rinsed with distilled water, drained and left to cool for 5 minutes at room temperature. The cooled cooked noodles were then reweighed. The cooked weighed was expressed in grams **Kamble et al (2018)**.

Statistical analysis

All data were expressed as the mean±SE and they were analyzed statistically using the one-way analysis of variance ANOVA followed by Duncan's test. In all cases $p<0.05$ was used as the criterion of statistical significance by SAS program **SAS, (1996)** according to the procedure reported by **Steel et al (1997)**.

RESULTS AND DISCUSSION

Proximate composition of noodles

Data given in **Table (1)** indicated that the moisture, ash, protein and crude fiber percent increased, when rice flour ratio decreased in the noodles owing to their lower contents in rice flour than wheat flour. On the other hand, the fat and total carbohydrate content increased with increasing rice flour ratio in the noodles. Energy value content of different blends ranged between 377.64 to 421.43 Kcal/100g, the highest values were observed for the rice-based noodles. An elevation in rice flour levels in the blends leads to increasing energy value reaching its maximum value at the ratio of 20WF:80RF. This was expected as rice was composed of mainly carbohydrate-rich materials. These findings are in accordance with those reported by **Ishfaq et al (2015).**

Table 1. Effect of rice flour incorporation on proximate composition of noodles (g/100g)

Composition	Noodles				
	T1	T2	T3	T4	T5
Moisture	5.33^{a}±0.20	5.39^{a}±0.11	4.76^{b}±0.11	4.32^{c}±0.10	4.02^{c}±0.04
Ash	5.22^{a}±0.30	5.85^{a}±0.29	3.53^{b}±0.21	2.54^{c}±0.29	1.11^{d}±0.22
Fat	4.62^{d}±0.19	5.14^{cd}±0.44	6.11^{bc}±0.57	7.11^{b}±0.44	8.91^{a}±0.36
Protein	12.81^{a}±0.10	11.78^{b}±0.13	10.71^{c}±0.21	9.64^{d}±0.22	8.57^{e}±0.12
Crude Fiber	0.82^{a}±0.01	0.77^{ab}±0.03	0.73^{bc}±0.01	0.69^{cd}±0.03	0.65^{d}±0.01
Total Carbohydrate	71.18^{c}±0.16	71.11^{c}±0.76	74.18^{b}±0.72	75.68^{ab}±0.44	76.74^{a}±0.61
Energy value (Kcal/100g)	377.64^{d}±1.75	377.64^{d}±0.86	394.21^{c}±2.33	405.36^{b}±2.25	421.43^{a}±1.27

Data are mean ± SE, n=3, means on the same lines having different superscripts are significantly different at 5%.
Where: T1: (WF 100: RF 0); T2: (WF 80: RF 20); T3: (WF 60: RF 40); T4: (WF 40: RF 60); T5: (WF 20: RF 80).

Scavenging activity of noodles

The data presented in **Table (2)** showed that scavenging activity in noodles ranged from 22.2 to 36.8 %. The highest percentage was observed for a sample containing 80% rice flour followed by sample T4, and gradually stepped down with raising wheat flour level till reached the lowest value for wheat-based noodle containing 100% wheat flour. These results are in harmony with those obtained by **Adom and Liu, (2002)**.

Table 2. Effect of rice flour incorporation on scavenging activity of noodles

Noodles	Scavenging activity %
T1: (WF 100: RF 0)	$22.18^{d} \pm 0.14$
T2: (WF 80: RF 20)	$22.88^{d} \pm 0.22$
T3: (WF 60: RF 40)	$32.48^{c} \pm 0.10$
T4: (WF 40: RF 60)	$34.19^{b} \pm 0.10$
T5: (WF 20: RF 80)	$36.79^{a} \pm 0.49$

Data are mean ± SE, n=3, means on the same column having different superscripts are significantly different at 5%.

Evaluation of sensory attributes for cooked noodles

The cooked noodles were estimated for their sensory attributes included taste, odor, color, chewiness and overall acceptability as shown in **Table 3**. The data revealed that sensory characteristics scores significantly decreased as the rice flour content increased. The noodles supplemented with up to 40% rice flour received the same acceptability as the control. Therefor, utilization the rice flour sublementation ratio 40% could observed good sensory characteristics like wheat-based noodles.

Cooking quality characteristics

Noodle quality could be estimated from cooking attributes, such as cooking time, cooking loss, water absorption, swelling index and cooked weight. Data in **Table 4**. containg cooking time, cooking loss and water absorption showed that wheat-based noodles had prolonged cooking time than rice based noodles. Regarding to cooking loss of rice based noodles was higher than wheat-based noodles. On the other hand, the water absorption was found to range between 137.1 to 231.6 %, a higher values were due to the incorporation of rice flour . Also, decrease in protein percent were owing to their dilution as a result of rice flour incorporation, it might be responsible for less water retention and increase in water uptake of the noodles.

Table 3. Effect of rice flour incorporation on sensory evaluation of cooked noodles

Noodles	Sensory characteristics				
	Taste	Odor	Color	Chewiness	Overall acceptability
T1	$8.1^{a}\pm0.31$	$8.2^{a}\pm0.35$	$8.2^{a}\pm0.29$	$8.3^{a}\pm0.33$	$8.4^{a}\pm0.31$
T2	$8.2^{a}\pm0.24$	$8.6^{a}\pm0.22$	$8.3^{a}\pm0.21$	$8.0^{a}\pm0.21$	$8.1^{a}\pm0.17$
T3	$7.8^{a}\pm0.41$	$7.9^{ab}\pm0.27$	$8.0^{a}\pm0.25$	$7.9^{a}\pm0.27$	$8.3^{a}\pm0.33$
T4	$6.3^{b}\pm0.39$	$6.7^{bc}\pm0.61$	$6.8^{b}\pm0.61$	$6.4^{b}\pm0.45$	$6.2^{b}\pm0.44$
T5	$5.2^{b}\pm0.51$	$6.3^{c}\pm0.66$	$6.0^{b}\pm0.53$	$4.9^{c}\pm0.45$	$5.4^{b}\pm0.60$

Data are mean ± SE, n=3, means on the same column having different superscripts are significantly different at 5%.
Where: T1: (WF 100: RF 0); T2: (WF 80: RF 20); T3: (WF 60: RF 40); T4: (WF 40: RF 60); T5: (WF 20: RF 80).

Table 4. Effect of rice flour incorporation on cooking quality of noodles

Noodles	Cooking time minutes	Cooking loss %	Water absorption %
T1: (WF 100: RF 0)	10.3^{a}±0.23	0.10^{d}±0.01	137.1^{e}±0.01
T2: (WF 80: RF 20)	9.1^{b}±0.10	0.10^{d}±0.01	200.1^{c} ±0.01
T3: (WF 60: RF 40)	8.5^{bc}±0.23	0.17^{c}±0.01	231.6^{a}±0.01
T4: (WF 40: RF 60)	8.1^{c}±0.10	0.60^{a}±0.01	164.9^{d}±0.01
T5: (WF 20: RF 80)	6.5^{d}±0.23	0.42^{b}±0.01	205.6^{b}±0.01

Data are mean ± SE, n=3, means on the same column having different superscripts are significantly different at 5%.

Regarding to cooked weight, it was variated from 23.74 grams recorded in wheat-based noodles to 33.24 grams recorded in T3 which incorporated by 40 % rice flour as showen in **Table 5**. The higher cooked weight of rice noodle could be resone to the elevate swelling ability of the noodles as seen in Table 5, which poited out that the maximum swelling index was recorded in noodle incorporated by 80% rice flour. Therefore, blends with high incorporation by rice flour decresed the properties of dough, nutrient density and cooking attributes of noodles. These findings are supported by the observation of **Kaushal and Sharma (2014); Sirichokworrakita et al (2015) and Kamble et al (2018)**.

Table 5. Effect of rice flour incorporation on swelling index and cooked weight of noodles

Noodles	Swelling index (%)	Cooked weight (g)
T1: (WF 100: RF 0)	3.95^{d}±0.10	23.74^{e}±0.11
T2: (WF 80: RF 20)	3.20^{e}±0.01	30.11^{c}±0.02
T3: (WF 60: RF 40)	4.29^{c}±0.01	33.24^{a}±0.02
T4: (WF 40: RF 60)	5.10^{b}±0.03	26.61^{d}±0.10
T5: (WF 20: RF 80)	5.38^{a}±0.04	30.68^{b}±0.02

Data are mean ± SE, n=3, means on the same column having different superscripts are significantly different at 5%.

CONCLUSION

Based on the aforementioned data, we could conclude that proximate composition including moisture, ash, crude fiber and protein content increased significantly; while; fat, total carbohydrate and energy value contents reduced significantly in the noodle blends having greater percent of wheat flour. The noodles supplemented with rice flour revealed preferable sensory and cooking quality attributes up to 40 % incorporation of rice flour. These findings promote the utilization of rice flour for the production functional noodles with high nutritional properties.

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تطوير وتقييم المعكرونة المعدة من خلطات دقيق الأرز والقمح

[122]

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الموجـــــــز

تم إنتاج المعكرونة عن طريق دمج نسب متفاوتة (0 ، 20 ، 40 ، 60 و 80٪) من دقيق الأرز بدلاً من دقيق القمح، والتي تم تقييمها من حيث التركيب الكيميائي، نشاط الكسح، الخواص الحسية وخصائص جودة الطهي. تباين التركيب الكيميائي للمعكرونة غير المطهية بصورة معنوية، والتي إحتوت على رطوبة (4.02-5.33٪)، ورماد (1.11- 5.22٪)، وألياف خام (0.65-0.82٪) والبروتين (8.57-12.81٪)؛ التي زادت عند خفض نسبة دقيق الأرز في المعكرونة؛ بينما زادت الدهون (4.62-8.91٪) والكربوهيدرات الكلية (71.11-76.74٪) وقيمة الطاقة (377.64- 421.43 كيلو كالوري / 100 جم) بزيادة كمية دقيق الأرز في المعكرونة. تراوحت فعالية مضادات الأكسدة بين 36.8 ٪ للعينة التي تحتوي على دقيق الأرز بنسبة 80 ٪ إلى 22.2 ٪ لدقيق القمح في المعكرونة القائمة على القمح بنسبة 100 ٪ كنشاط كاسح للجذور الحرة. تم تقييم درجة القبول الحسى للمعكرونة التي تم إعدادها، وقد أظهرت المعكرونة القائمة على القمح (WF: RF 100: 00) تفوق في الخصائص الحسية. بينما خلطات دقيق المعكرونة الأخري، حصلت المعكرونة المدمج بها دقيق الأرز بنسبة تصل إلى 40٪ على نفس درجة القبول للمعكرونة القائمة على القمح. إختلفت خصائص جودة الطبخ بشكل كبير بين عينات المعكرونة. تراوحت مدة الطهي من 6.5 إلى 10.3 دقيقة وكانت مرتفعة في المعكرونة القائمة على القمح مقارنة بالمعكرونة من دقيق الأرز. تراوحت نسبة فاقد الطهي ونسبة امتصاص الماء والوزن المطبوخ وقيم معامل الإنتفاخ من 0.1 إلى 0.6 ٪ ومن 137.1 إلى 231.6 ٪ ومن 23.74 إلى 33.24 جم / جم ومن 3.20 إلى 5.38 ٪ على التوالي؛ والتى كشفت عن إنخفاض معنوى فى الخصائص الوظيفية للعجين ومعايير جودة الطهي مع زيادة إضافة دقيق الأرز في المعكرونة. أوضحت الدراسة أن المعكرونة المحضرة من مخاليط دقيق القمح والأرز أظهرت أن أفضل الصفات الحسية المقبولة وخصائص جودة الطهي كانت بنسبة خلط 40٪ من دقيق الأرز مع 60 % دقيق القمح. هذه النتائج تعزز الإستفادة من دقيق غير التقليدي مثل دقيق الأرز لإنتاج معكرونة ذات قيمة غذائية عالية.

الكلمات الدالة: المعكرونة، دقيق الأرز، دقيق القمح، جودة الطهي والتقييم الحسي

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