

ESTIMATION OF PROTEIN DIGESTIBILITY IN BRAN FROM DIFFERENT RICE VARIETIES

Danica Andreevska¹, Dobre Andov¹, Natasha Gjorgovska^{2*}, Vesna Levkov²,
Mirjana Menkovska², Svetlana Grigorova³, Trajche Dimitrovski⁴

¹Field Crops Department, Institute of Agriculture, "Ss. Cyril and Methodius" University in Skopje,
Blvd. Aleksandar Makedonski bb, 1000 Skopje, Republic of Macedonia

²Department of Nutrition and Foodstuffs Processing, Institute of Animal Science,
"Ss. Cyril and Methodius" University in Skopje, Blvd. Ilinden 92a, Skopje, Republic of Macedonia

³Nutrition and Feed Technologies Department, Institute of Animal Sciences, Kostinbrod, Bulgaria

⁴Institute of Agriculture, "Ss. Cyril and Methodius" University in Skopje,
Blvd. Aleksandar Makedonski bb, 1000 Skopje, Republic of Macedonia

*natashagjorgovska@gmail.com

A b s t r a c t: Rice is an important cereal crop in the Republic of Macedonia. The process of the post-production of paddy rice results in certain categories of products: brown rice (or cargo), white rice, broken rice, rice hull and rice bran as by-products, which have a wide variety of applications. The focus of our study was to estimate the protein digestibility in rice bran of 8 rice varieties (*Prima riska* – as standard, *San Andrea*, *Onice*, *Gloria*, *Roma*, *Gala*, *Halilbey* and *Gönen*). The protein digestibility was determined using in vitro method with pepsin dissolved in HCl. There was a statistically significant difference between the rice varieties in the digestibility of protein and in total fat. The protein digestibility of rice bran ranged from 81.79% in the Turkish variety *Gönen* to 88.58% in the Italian variety *Gloria*. These results suggest that rice bran is a good source of protein with good biological value and digestibility

Key words: rice bran; protein; digestibility

ОЦЕНА НА СВАРЛИВОСТА НА ПРОТЕИНИТЕ ОД ОРИЗОВИ ТРИЦИ ОД РАЗЛИЧНИ СОРТИ ОРИЗ

A п с т р а к т: Оризот е важна житна култура во Република Македонија. Процесот на постпродукција на ориз резултира со одредени категории производи: кафеав ориз (или карго), бел ориз, кршен ориз, оризова арпа и оризови трици како нус-производи, кои имаат широк спектар на користење. Целта на нашата студија беше да се оцени сварливоста на протеините кај оризовите трици од 8 сорти ориз (*Prima riska* – како стандард, *San Andrea*, *Onice*, *Gloria*, *Roma*, *Gala*, *Halilbey* и *Gönen*). Сварливоста на протеините беше определена со употреба на методот in vitro со пепсин растворен во HCl. Имаше статистички значајна разлика помеѓу сортите на ориз во поглед на сварливоста на протеините и во вкупните масти. Сварливоста на протеините на оризовите трици се движи од 81,79% во турската сорта *Gönen* до 88,58% во италијанската сорта *Gloria*. Овие резултати укажуваат на тоа дека оризовите трици се добар извор на протеини со добра биолошка вредност и сварливост.

Клучни зборови: оризови трици; протеини; сварливост

1. INTRODUCTION

Rice is an important cereal crop in the Republic of Macedonia. The process of the post-production of paddy rice results in certain categories of products: brown rice (or cargo), white rice, broken

rice, rice hull and rice bran as by-products, which have a wide variety of applications (Andreevska *et al.* 2017). Rice bran is a by-product of rice milling industry and constitutes around 10% of the total weight of rough rice (Hu *et al.*, 1996). It is mainly composed of aleurone, pericarp, subaleurone layer

and germ. Rice bran is a rich source of vitamins, minerals, essential fatty acids, dietary fiber and other sterols (Gul *et al.*, 2015). According to Bocevaska (2006), the rice bran is a good source of nutritive, stable and healthy oil. Rice bran is rich in B-vitamins and tocopherols and its nutrient density and profiles of amino-acids and fatty acids, including 74% of unsaturated fatty acids, are superior to those of cereal grains. Both rice bran protein and fat are of relatively high biological value (Khan, 2004). Digestibility of protein is one of the most important data for estimating the protein quality (Han *et al.*, 2015). The focus of this study was to estimate the protein digestibility in rice bran using in vitro method with pepsin dissolved in HCl, in order to suggest rice bran as a new protein source in animal nutrition.

MATERIALS AND METHODS

The chemical analyses and protein digestibility estimation were conducted on rice bran samples from eight varieties of rice (*Oryza sativa* L.). The list of the tested bran samples is given in the Table 1.

Table 1

List of rice bran samples from different rice varieties

No.	Variety	Country of origin
1.	Prima riska (st.)	Macedonia
2.	San Andrea	Italy
3.	Onice	Italy
4.	Gloria	Italy
5.	Roma	Italy
6.	Gala	Turkey
7.	Halilbey	Turkey
8.	Gönen	Turkey

Protein digestibility

Protein digestibility of rice bran samples was analyzed using pepsin enzyme dissolved in HCl according to AOAC 971.09 with modifications. The pepsin was dissolved in 0.075N HCl, previously warmed to 40–42°C. To each defatted sample in flask, 150 ml of freshly prepared pepsin solution

was added. The sample was incubated at temperature of 42–45°C and constantly agitated during 16 hours' incubation. After incubation, the sample was filtered and the residue was transferred in a Kjeldahl flask to perform Kjeldahl digestion and extraction.

Chemical analyses of samples

After milling the rice bran using laboratory mill the samples were stabilized at room temperature. The chemical analyses comprised: moisture content, total protein content, total fat content and ash content. The moisture content was measured applying a standard drying method for the samples in an oven at the temperature of $105 \pm 5^\circ\text{C}$, till constant weight. The total protein content was determined according to Kjeldahl method ($\text{N} \times 5.95$). The total fat content was analyzed by extraction with diethyl ether according to the Soxhlet method. Ash content was determined by burning the samples in oven during 8 hours at the temperature of 600°C .

RESULTS AND DISCUSSION

In Table 2 are presented the minimal, maximal and average values of the percentage of husk and bran of different rice varieties analyzed in this study.

The bran percentage ranged from 6.85% in *Gala* variety to 9.90% in *Onice*. Rice variety *Roma* had the highest fraction of husks (24.15%), while *Gala* the lowest (18.45%). The percentages of bran and husk in the standard variety *Prima riska* were 9.55% and 21.10%, respectively.

Table 2

Amount of husk and bran yield of analyzed rice varieties (%)

No.	Variety	Husk			Bran		
		min	max	average	min	max	average
1.	<i>Prima riska</i> (st.)	20.1	22.1	21.10	8.9	10.2	9.55
2.	<i>San Andrea</i>	19.7	22.0	20.85	6.1	9.0	7.55
3.	<i>Onice</i>	18.0	23.6	20.80	6.4	13.4	9.90
4.	<i>Gloria</i>	20.4	22.4	21.40	8.7	9.2	8.95
5.	<i>Roma</i>	23.1	25.2	24.15	7.3	9.8	8.55
6.	<i>Gala</i>	18.0	18.9	18.45	5.9	7.8	6.85
7.	<i>Halilbey</i>	19.7	23.6	21.65	6.0	8.6	7.30
8.	<i>Gönen</i>	18.7	19.8	19.25	6.7	7.7	7.20

Table 3 presents the approximate chemical composition in rice bran. The average moisture content in the bran of the investigated rice varieties ranged from $11.87 \pm 0.24\%$ in the variety *Gala* to $13.57 \pm 0.12\%$ in *Halilbey*. *San Andrea*, *Gloria* and *Halilbey* had significantly higher moisture content ($P \leq 0.01$) compared to the standard *Prima riska*.)

The highest lipid content (Table 3) in the rice bran was found in the variety *Gönen* ($14.29 \pm 0.32\%$), and the lowest in the variety *San Andrea* ($10.12 \pm 0.08\%$). *Onice*, *Roma*, *Gala* and *Gönen* had significantly higher ($p \leq 0.01$), while *San Andrea* significantly lower lipid content ($p \leq 0.01$) compared to the standard variety *Prima riska*. The average ash content in the rice bran ranged from $6.76 \pm 0.12\%$ for the variety *San Andrea* to $10.46 \pm 0.10\%$ for the variety *Gönen*. In the varieties *San*

Andrea, *Gloria*, *Roma* and *Halilbey* the ash content was significantly lower ($p \leq 0.01$) compared to the standard variety *Prima riska*, while the varieties *Gönen* ($p \leq 0.01$) and *Gala* ($p \leq 0.05$) contained significantly higher ash content than the standard. The approximate chemical composition of rice bran is similar with the results reported by Singh et al. (2013), Satter et al. (2014) and Andreevska et al. (2017).

The carbohydrates content ranged from $58.69 \pm 0.65\%$ in variety *San Andrea* (the highest average) to $50.16 \pm 0.79\%$ in the variety *Gönen* (the lowest).

In comparison to the standard *Prima riska*, the content of carbohydrates was significantly higher in *San Andrea* ($p \leq 0.01$), *Gloria* ($p \leq 0.01$) and *Halilbey* ($p \leq 0.05$), while significantly lower in *Onice* and *Gönen* ($p \leq 0.01$).

Table 3

Approximate chemical composition of different varieties' rice bran (%)

No.	Variety	Moisture	Lipid	Ash	Carbohydrates
1.	<i>Prima riska</i> (st.)	12.00±0.26	11.15±0.11	9.96±0.08	54.01±0.29
2.	<i>San Andrea</i>	13.16±0.38**	10.12±0.08**	6.76±0.12**	58.69±0.65**
3.	<i>Onice</i>	12.24±0.18	13.73±0.10**	9.97±0.21	51.24±0.11**
4.	<i>Gloria</i>	12.80±0.17**	11.22±0.19	9.00±0.13**	55.27±0.33**
5.	<i>Roma</i>	12.15±0.40	11.69±0.23**	9.46±0.07**	53.89±0.13
6.	<i>Gala</i>	11.87±0.24	11.85±0.25**	10.41±0.17*	54.67±0.24
7.	<i>Halilbey</i>	13.57±0.12**	10.83±0.30	8.94±0.40**	55.00±0.47*
8.	<i>Gönen</i>	12.14±0.52	14.29±0.32**	10.46±0.10**	50.16±0.79**
	Average	12.49	11.86	9.37	54.11
	LSD 0.05	0.56	0.39	0.34	0.73
	LSD 0.01	0.78	0.54	0.47	1.02

Values are means \pm S.D., * $p \leq 0.05$; ** $p \leq 0.01$; compared to the standard variety *Prima riska*

The rice bran as shown in Table 4 contains high crude protein amount, ranging from $11.19 \pm 0.06\%$ in *Gala* variety to $12.95 \pm 0.30\%$ in *Gönen* variety, which makes them a moderately good source of protein. In the varieties *San Andrea*, *Gloria*, *Gala* and *Halilbey* the crude protein content in the bran was significantly lower than in the standard ($p \leq 0.01$).

The presented results are similar to the ones by Satter et al. (2014), who reported protein content

in bran from 12.26 to 14.01%. Pepsin digestibility was the highest for *Gloria* variety ($88.58 \pm 0.71\%$), followed by *San Andrea* ($88.46 \pm 1.55\%$), and the lowest in *Gönen* ($81.79 \pm 2.19\%$). In the varieties *San Andrea* and *Gloria* digestibility was significant higher than the standard ($p \leq 0.01$). The results obtained in this study show lower values for protein digestibility compare to the results of Han et al. (2015).

Table 4
Content of protein and digestibility of protein
in different rice varieties (%).

No.	Variety	Protein	Digestibility of protein
1.	<i>Prima riska</i> (st.)	12.88±0.03	83.28±2.26
2.	<i>San Andrea</i>	11.27±0.18**	88.46±1.55**
3.	<i>Onice</i>	12.82±0.19	85.16±1.26
4.	<i>Gloria</i>	11.70 ± 0.43**	88.58 ± 0.71**
5.	<i>Roma</i>	12.80 ± 0.37	82.68 ± 3.06
6.	<i>Gala</i>	11.19 ± 0.06**	86.24 ± 2.81
7.	<i>Halilbey</i>	11.66 ± 0.41**	84.69 ± 1.18
8.	<i>Gönen</i>	12.95 ± 0.30	81.79 ± 2.19
Average		12.16	85.11
LSD 0.05		0.47	3.66
LSD 0.01		0.66	5.07

* $p \leq 0.05$;

** $p \leq 0.01$; compared to the standard variety *Prima riska*,
Values are means ± S.D.

CONCLUSION

The rice bran showed good nutritional quality in all (the) 8 rice varieties. The moisture, lipid, protein, carbohydrate and ash contents showed highly significant differences among the rice varieties. The protein digestibility of rice bran ranged from 81.79% in the Turkish variety *Gönen* to 88.58% in the Italian variety *Gloria*. These results suggest that

rice bran is a good source of protein with good biological value and digestibility.

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