

BYPRODUCTS OF PRODUCTION OF RICE GOOD RAW MATERIAL FOR ANIMAL PRODUCTION IN MACEDONIA

Dobre Andov¹, Danica Andreevska¹, Vladimir Medarski²

¹*Ss. Cyril and Methodius University in Skopje, Agricultural Institute, Skopje,
Department of Rice – Kočani, Nikola Karev No. 8, Republic of Macedonia*

²*The Agency for Development of the Agriculture of Republic of Macedonia, Bitola, PE Kočani
dr_andov@yahoo.com*

Before starting with the organization of vegetable or animal production it is necessary an identification of the required conditions and raw materials to be made. The secondary products of rice used as raw materials for animal production until now have not been worked on enough in the Republic of Macedonia. In this work it will be presented and analyzed the results of the examination (twenty years long average) of the seeded areas, the production of paddy rice, straw and the secondary products with the reproduction of paddy rice (hull and bran). The yield of straw in sorts is established in field experiments, and the quantity of hull and bran are calculated according to the percentage that has been obtained with the laboratory analysis. In Macedonia the rice is maintained on 4 189 ha of area and prevailing sorts are: *Monticeli* (2 471ha), *r-76/6* (1 381ha), *San Andrea* (1 301ha) and *Prima riska* (392ha). The results of the examinations show that yearly the average production is 19 157 tons of paddy rice, 37 411 tons of straw, 3 615 tons of hull and 2067 tons of bran. The results of this work are going to have first of all a practical use for the existing and future farmers for the superior potential of the raw materials of rice production in animal production.

Key words: paddy rice; straw; hull; bran; raw materials; animal production

СПОРЕДНИТЕ ПРОИЗВОДИ ОД ПРОИЗВОДСТВОТО НА ОРИЗ – ДОБРА СУРОВИНА ЗА СТОЧАРСТВОТО ВО МАКЕДОНИЈА

Пред започнување со растително или сточарско производство потребно е да се направи идентификација на потребните услови и суровини за тоа производство. На споредните производи од одгледувањето на ориз како суровина за сточарското производство досега кај нас не е обрнувано доволно внимание. Во овој труд се презентирани и анализирани резултатите од истражувањето (дваесетгодишен просек) на засеаните површини, на производството на суров ориз (арпа), оризова слама и споредни производи добиени при преработката на арпата (оризови лушпи и трици). Приносот на слама по сорти е утврден во полски експерименти, а количините на оризови лушпи и трици се пресметани според процентот добиен со лабораториска анализа. Во Македонија оризот е застапен во просек на површина од 4189 ha, при што водечки сорти се: *монтичели* (2471 ha), *p-76/6* (1381 ha), *сан андреа* (1301 ha) и *прима риска* (392 ha). Резултатите од истражувањата покажуваат дека просечно годишно се произведуваат 19157 тони оризова арпа, 37411 тони слама, 3615 тони лушпи и 2067 тони оризова плева. Резултатите од овој труд ќе имаат пред сè практична примена кај сегашните и идни фармери за користење на расположливиот потенцијал на суровините од оризопроизводството во сточарството.

Клучни зборови: оризова арпа; слама; лушпи; трици; суровина; сточарско производство

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the oldest agricultural plants. It was well known long time ago for the people of East Asia, 7000 years BC. It

originates from south-east Asia, from where it is transmitted and spread all over the world (Boaksen and Suja, 1984).

Today it is grown on all the continents and is main diet for the human population in the world.

The rice will continue to be the main source of food in future. It is mostly grown in Asia, where it is the main food for 60 % of the population.

Even though the rice is not main diet for the people from the Republic of Macedonia, it is an important agricultural plant because it is a crop harvested as unpeeled grain and other new products per unit. As an agricultural plant the rice is of big importance, because it provides high crops harvest on fields where other grains are less successful.

The production of rice in Macedonia is mainly concentrated in the east region, in the area of Kočani, Štip, Vinica and Blatec.

Rice is the main source of food and that is why it is of huge importance as well as the products made of it such as broken rice, the rice straw, bran and the hulls.

In the scientific and specialized literature in this area so far the products made of rice are not processed well enough, and some are of big importance for the farming.

That is the reason why the main purpose of this work will be presenting and analyzing the results of (in average twenty years) the production of paddy rice and byproducts (straw, bran and hulls) in the Republic of Macedonia.

MATERIAL AND METHODS

The crop harvest of unpeeled rice (paddy rice) and straw classified according to the type, variety and years of production is confirmed with experiments proceeded on the fields at the time of crop.

The calculation of the quantity amount of the new products (products made of rice) is based on the crop harvest and the percentage obtained in the year of production. The percentage of byproducts (bran and hulls) made of the whole grain of rice with its preparation is defined with the laboratory peeler for each variety separately.

RESULTS AND DISCUSSION

Planted areas, average yields and total production of rice in Macedonia

In Table 1 the results of planted areas, the average yields and the total production of rice in the Republic of Macedonia are shown for the period from 1989 to 2008 year. This table shows that the average areas planted with rice are 4189 ha, and

the largest surfaces with rice were planted in 1990 (8880 ha) and the smallest in 1994 (1200 ha).

The highest average yield of paddy rice is achieved in 2003 (6500 kg/ha) and the lowest in 1993 (1830 kg/ha). The average crop harvest is 4744 kg/ha.

The total production of paddy rice for the period analyzed amounts on average to 19143 tons (6120 in 1994 and 42000 tons in 1992).

Table 1

Planted areas, average yields and total production of rice in Macedonia

Year	Areas (ha)	Average yield of paddy rice (kg/ha)	Total production of paddy rice (tons)
1989	6 056	4 536	27 675
1990	8 880	3 100	27 386
1991	8 692	4 314	37 497
1992	8 465	5 000	42 000
1993	3 500	1 830	6 420
1994	1 200	5 100	6 120
1995	1 316	5 200	6 843
1996	4 800	5 300	25 440
1997	5 500	3 600	19 800
1998	3 905	4 800	18 744
1999	3 455	4 870	16 825
2000	4 510	4 530	20 430
2001	1 978	4 200	8 307
2002	2 450	4 500	11 025
2003	3 962	6 500	25 753
2004	3 870	5 000	19 350
2005	2 700	5 500	14 850
2006	2 886	6 000	17 316
2007	2 853	5 000	14 265
2008	2 800	6 000	16 800
Average	4 189	4 744	19 143

Areas of rice per years and per varieties

The existing varieties of rice in rice productions and planted areas change every year according to the production and they mainly affect the entire crop harvest of rice and products made of it. During the past period of rice production in our

country varieties of introduction (mostly Italian and Bulgarian) and home local sorts were spread.

According to the results shown in Table 2 it can be seen that during the analyzed period on the largest areas the sort *Montichelli* (2471 ha) was mostly represented. The largest areas of this variety (*Montichelli*) were planted in 1992 (6727 ha).

During this period the fields planted with the variety *Montichelli* are dramatically decreasing and the main part of the area is planted with the varieties *San Andrea* (1301 ha) and *R-76/6* (1381 ha). Of domestic varieties *Prima riska* (392 ha) is planted on the largest areas and the variety *biser-2* (36 ha) is planted on the smallest areas.

Table 2

Areas of rice per years and per varieties (ha)

Year	Varieties							Total
	<i>Monticeli</i>	<i>R-76/6</i>	<i>Osogovka</i>	<i>Kočanski</i>	<i>Biser-2</i>	<i>San Andrea</i>	<i>Prima riska</i>	
1989	2 156	3 587	218	90	–	–	–	6 051
1990	5 209	3 300	197	131	41	–	–	8 878
1991	5 434	2 942	162	108	44	–	–	8 690
1992	6 727	1 738	–	–	–	–	–	8 465
1993	2 077	1 386	–	–	37	–	–	3 500
1994	921	259	–	–	20	–	–	1 200
1995	567	749	–	–	–	–	–	1 316
1996	2 789	2 011	–	–	–	–	–	4 800
1997	2 798	2 702	–	–	–	–	–	5 500
1998	3 181	566	–	–	–	157	–	3 904
1999	3 053	350	–	–	–	52	–	3 455
2000	2 729	877	–	–	–	929	–	4 535
2001	1 190	344	–	–	–	443	–	1 977
2002	–	1 541	–	–	–	908	–	2 449
2003	–	–	–	–	–	3 962	–	3 962
2004	1 290	–	–	–	–	2 580	–	3 870
2005	–	519	–	–	–	1 090	1 090	2 699
2006	422	488	–	–	–	1 643	333	2 886
2007	535	775	–	–	–	1 494	49	2 853
2008	930	719	–	–	–	1 054	96	2 799
Average	2 471	1 381	192	110	36	1 301	392	4 189

Production of paddy rice per years and per varieties

The production of paddy rice per years and per varieties is shown in Table 3. From the table the average production of paddy rice can be seen for the period of twenty years and amounts to 19157 tons and varies from 6120 tons (in 1994) to 42325 tons (in 1992).

The highest average production of paddy rice is received from the variety *Montichelli* (10826 t), on the second place is *San Andrea* (7224 t), on the third *R-76/6* with average production of 5932 t. The lowest average production of paddy rice for the analyzed period is obtained from the variety *Biser-2* (122 t).

Table 3

Production of paddy rice per years and per varieties (t)

Year	Varieties							Total
	<i>Monticeli</i>	<i>R-76/6</i>	<i>Osogovka</i>	<i>Kočanski</i>	<i>Biser-2</i>	<i>San Andrea</i>	<i>Prima riska</i>	
1989	9 780	16 271	989	408	–	–	–	27 448
1990	16 148	10 230	611	406	127	–	–	27 522
1991	23 442	12 692	699	466	190	–	–	37 489
1992	33 635	8 690	–	–	–	–	–	42 325
1993	3 801	2 536	–	–	68	–	–	6 405
1994	4 697	1 321	–	–	102	–	–	6 120
1995	2 948	3 895	–	–	–	–	–	6 843
1996	14 782	10 658	–	–	–	–	–	25 440
1997	10 073	9 727	–	–	–	–	–	19 800
1998	15 269	2 717	–	–	–	754	–	18 740
1999	14 868	1 705	–	–	–	253	–	16 826
2000	12 362	3 973	–	–	–	4 208	–	20 543
2001	4 998	1 445	–	–	–	1 861	–	8 304
2002	–	6 935	–	–	–	4 086	–	11 021
2003	–	–	–	–	–	25 753	–	25 753
2004	6 450	–	–	–	–	12 900	–	19 350
2005	–	2 855	–	–	–	5 995	5 995	14 845
2006	2 532	2 928	–	–	–	9 858	1 998	17 316
2007	2 675	3 875	–	–	–	7 470	245	14 265
2008	5 580	4 314	–	–	–	6 324	576	16 794
Average	10 826	5 932	766	427	122	7 224	2 204	19 157

Production of straw of rice per years and per varieties

The rice straw is used in animals diets, for preparation of silages with some fodder plants such as alfalfa, forage pea, chickling. Straw is good for the paper industry and is used in the mushroom production and preparation as well as in plantation production.

The received amount of straw mostly depends on the variety and the use of agrotechnic on higher amounts of manure and it increases the production of rice straw per unit (Bojadžieva, 1981; Andreevska et al., 2000, 2004, 2005/2006, 2007; Ilieva et al., 1999, 2005/2006).

Table 4 shows that the average production of rice straw for the period of twenty years amounts to 37411 tons, and varies from 11334 tons (in

1994) to 77984 tons (in 1992). The average production of rice straw classified per varieties amount to *Monticelli* – 19129 t, *San Andrea* – 15351 t, *R-76/6* – 12663 t and *Biser-2* – 255 t.

Production of hulls of rice per years and per varieties

According to Rutger (1975) unpeeled (paddy) rice with preparation gives around 20% hulls, 8% bran, 2% for polishing and 70% white rice.

Because the rice paddy grain is enveloped in glumes it is not suitable for eating. That is why, to eliminate them, during the post-harvesting processing there are factories (mills) that are completely equipped with special machines for each operation.

Table 4

Production of straw of rice per years and per varieties (t)

Year	Varieties							Total
	<i>Monticeli</i>	<i>R-76/6</i>	<i>Osogovka</i>	<i>Kočanski</i>	<i>Biser-2</i>	<i>San Andrea</i>	<i>Prima riska</i>	
1989	17 281	34 735	1 837	695	–	–	–	54 584
1990	28 534	21 839	1 135	691	266	–	–	52 465
1991	41 422	27 095	1 298	793	398	–	–	71 006
1992	59 433	18 551	–	–	–	–	–	77 984
1993	6 716	5 414	–	–	143	–	–	12 273
1994	8 300	2 820	–	–	214	–	–	11 334
1995	5 209	8 315	–	–	–	–	–	13 524
1996	26 120	22 753	–	–	–	–	–	48 873
1997	17 799	20 765	–	–	–	–	–	38 564
1998	26 981	5 800	–	–	–	1 602	–	34 383
1999	26 272	3 640	–	–	–	538	–	30 450
2000	21 844	8 482	–	–	–	8 942	–	39 268
2001	8 832	3 085	–	–	–	3 955	–	15 872
2002	–	14 805	–	–	–	8 683	–	23 488
2003	–	–	–	–	–	54 725	–	54 725
2004	11 397	–	–	–	–	27 412	–	38 809
2005	–	6 095	–	–	–	12 739	12 739	31 573
2006	4 474	6 251	–	–	–	20 948	4 246	35 919
2007	4 727	8 272	–	–	–	15 874	521	29 394
2008	9 860	9 210	–	–	–	13 439	1 224	33 733
Average	19 129	12 663	1 423	726	255	15 351	4 683	37 411

The percentage of hulls by Milev (1968) is variety characteristic and it is needed into normal (regular) soil and climate conditions.

The amount of rice products with the procedure of milling the paddy rice varies a lot with different varieties grown in different regions and conditions (different terms of planting, one side manurring, unproporcional procedure of irrigation).

Table 5 presents the results of rice hulls production per years and per varieties. This table shows that the whole average production of rice hulls amounts to 3615 tones, and varies from 1153 tons (1994) to 7965 tons (1992). The average amount of rice hulls is: *Montichelli* – 2 035 t, *San Andrea* – 1373 t, *R-76/6* – 1121 t and *Biser-2* – 24 t.

Production of bran of rice per years and per varieties

The rice bran is a solid base for making concentrates for food for domestic animals.

From the results shown in Table 6 it can be summed up that the whole average production of rice bran for the period analyzed is 2067 t, where the highest crop harvest is confirmed in 1992 (4563 t) and the smallest in 1994 (659 t).

If we analyze the harvest according to the varieties it can be seen that the highest average income is confirmed with the sort *Montichelli* (1169 t), and the lowest with the sort – *Biser -2* (13 t).

According to the researches by Andov (1999, 2003) the varieties with higher percentage of proteins are more resistant than the procedure of milling and they give less rice bran.

Table 5

Production of hulls of rice per years and per varieties (t)

Year	Varieties							Total
	Monticeli	R-76/6	Osogovka	Kočanski	Biser-2	San Andrea	Prima riska	
1989	1839	3 075	198	78	–	–	–	5 190
1990	3 036	1 933	122	78	25	–	–	5 194
1991	4 407	2 399	140	89	38	–	–	7 073
1992	6 323	1 642	–	–	–	–	–	7 965
1993	715	479	–	–	14	–	–	1 208
1994	883	250	–	–	20	–	–	1 153
1995	554	736	–	–	–	–	–	1 290
1996	2 779	2 014	–	–	–	–	–	4 793
1997	1 894	1 838	–	–	–	–	–	3 732
1998	2 871	5 14	–	–	–	143	–	3 527
1999	2 795	322	–	–	–	48	–	3 165
2000	2 324	751	–	–	–	800	–	3 875
2001	940	273	–	–	–	354	–	1 567
2002	–	1 311	–	–	–	776	–	2 087
2003	–	–	–	–	–	4 893	–	4 893
2004	1 213	–	–	–	–	2 451	–	3 664
2005	–	540	–	–	–	1 139	1 109	2 788
2006	476	553	–	–	–	1 873	370	3 272
2007	503	732	–	–	–	1 419	45	2 699
2008	1 049	815	–	–	–	1 202	107	3 173
Average	2 035	1 121	153	82	24	1 373	408	3 615

Table 6

Production of bran of rice per years and per varieties (t)

Year	Varieties							Total
	Monticeli	R-76/6	Osogovka	Kočanski	Biser-2	San Andrea	Prima riska	
1989	1 056	1 741	129	51	–	–	–	2 977
1990	1 744	1 095	79	51	13	–	–	2 982
1991	2 532	1 358	91	58	20	–	–	4 059
1992	3 633	930	–	–	–	–	–	4 563
1993	411	271	–	–	7	–	–	689
1994	507	141	–	–	11	–	–	659
1995	318	417	–	–	–	–	–	735
1996	1 596	1 140	–	–	–	–	–	2 736
1997	1 088	1 041	–	–	–	–	–	2 129
1998	1 649	2 91	–	–	–	79	–	2 019

Year	Varieties							Total
	Monticeli	R-76/6	Osogovka	Kočanski	Biser-2	San Andrea	Prima riska	
1999	1 606	182	–	–	–	27	–	1 815
2000	1 335	425	–	–	–	442	–	2 202
2001	540	155	–	–	–	195	–	890
2002	–	742	–	–	–	429	–	1 171
2003	–	–	–	–	–	2 704	–	2 704
2004	697	–	–	–	–	1 355	–	2 052
2005	–	305	–	–	–	629	809	1 743
2006	273	313	–	–	–	1 035	270	1 891
2007	289	415	–	–	–	784	33	1 521
2008	603	462	–	–	–	664	78	1 807
Average	1 169	635	100	53	13	758	298	2 067

CONCLUSION

According to the researches the following can be concluded:

– In Macedonia rice is planted on the average area of 4 189 ha (period of analysis from 1989 to 2008).

– Mostly varieties in production are: *Monticelli* average area of 2 471 ha, *R-76/6* – 1 381 ha, *San Andrea* – 1 301 ha and *Prima riska* – 392 ha.

– 19157 tons is the average production of paddy rice yearly.

– 37411 tons is the average annual production of rice straw.

– By processing paddy rice on average 3615 t hulls and 2067 t rice bran are produced.

– The straw and byproducts of rice (hulls and bran) are important source for the animal production in Macedonia.

REFERENCES

- [1] Andov D. (1997): Grain Yield and Protein Content in Paddy, Brown and White Rice of some Rice Varieties Grown as First and Second Crop. *Yearbook of The Institute of Agriculture*, Vol. **XVII**, 31–43. Skopje.
- [2] Andreevska Danica, Andov D., Ilieva Verica, Spasenoski M. (2000): Influence of Time and Method of Nitrogen Fertilisation on the Yield and the Grain Protein Content of some Rice Varieties. *Yearbook of The Institute of Agriculture*, Vol. **XX**, 48–59. Skopje.
- [3] Andov D., Najčevska Cvetanka, Andreevska Danica, Ilieva Verica (2003): White Rice Yield and Products Obtained during Paddy Rice De Hulling Depending on the Variety and Cultivation. *Proceedings of Papers XXVIII Meeting "Faculty with Farmers" 2003*, Vol. **11**, 115–125. Skopje.
- [4] Andreevska Danica, Jekić M., Ilieva Verica, Andov D., (2004): Prolonged Activity Effects of Mineral Fertilizers on White Rice Yield and Rice Protein Content. *Yearbook of the Institute of Agriculture*, Skopje, Vol. **XXII/XXIII**, 129–139.
- [5] Andreevska Danica, Ilieva Verica, Andov D., Zaseva Tanja (2005/2006): Effect of Foliar Split Application with Kristalon™ Special upon Yield and Dressing White Rice. *Yearbook of the Institute of Agriculture, Skopje*, Vol. **XXIV/XXV**, 61–73. Skopje.
- [6] Andreevska Danica, Ilieva Verica, Andov D., Zaseva Tanja (2007): Effect of basic fertilization and split application with different nitrogen fertilizers upon yield and quality of Prima riska – recently developed rice variety. *Yearbook of the Faculty of Agriculture, Goce Delčev University, Štip*, Vol. **VII**, 87–96.
- [7] Boaksen, H and Suja, C., (1984): Kina – 7000 godini odgledovanje na oriz. *Glasnik na UNESCO*, Dekemvri, Paris, France.
- [8] Bojadžieva, N. (1981): Upotreba kompleksnih (NPK) đubriva za povećanje prinosa pirinča. *Agrohemija*, N° 1–2, Beograd.
- [9] Vasilevski, G. I., Nikolov, P. (1997): *Oriz: proizvodstvo i prerabotka*. "Tribina Makedonska", s. 160; Biblioteka Agronauka, Skopje.
- [10] Ilieva Verica, Najčevska Cvetanka, Andov D., Andreevska Danica, Tomeva Elizabeta (1999): Characteristics of some new hybrid of rice genotypes. *Proceedings of Papers XXIV Meeting "Faculty with Farmers" '99*, Vol. **7**, 47–56. Skopje.
- [11] Ilieva Verica, Andreevska Danica, Andov D., Najčevska Cvetanka (2005/2006): Some more significant character-

istics of the new created rice varieties *Prima riska* and *Montesa* (*Oryza sativa* L.). *Yearbook of the Institute of Agriculture, Skopje*, Vol. **XXIV/XXV**, 51–59. Skopje.

[12] Милев В. (1968): *Проучуавания върху растения. Репродуктивни особености и условяване на технологи-*

ческите качества на одгледувани у нас оризове сортове. Пловдив.

[13] Rutger, J. N. and Qualset, C. O. (1972): *Plant breeding to increaese protein from cereal crops*. California.

[14] Rutger, J. N. (1975): *Breeding for increased protein in rice*, California.