SUSTAINABLE DEVELOPMENT IN RICE CULTIVATION AND NEW RICE PRODUCTS IN HUNGARY

Viktoria SZUTS
Tiborne BAKOS, Zoltan KERTAI, Dora TASNADY, Eniko VARGA, Bela M ORMAI, Ferenc OTVOS, Tomas TANCOS, Vivien SZABO, Fanny BALOG-VIG, Kitti BERCES, Gyula FAZEKAS, Antal VÉHA, Balazs P. SZABO, Jozsef CSANADI, Jozsef GAL

ABSTRACT: *Rice (Oryza L) is the species, which is most widely consumed grain staple food for human under wetland cultivation especially in Asia and Europe. Oryza sativa L as a cereal grain started cultivate about 600 years ago in Hungary and restarted the production in high quality at the latest decade. The first aim of this study was to follow the preparation of new rice products comparing different functional parameters in rice variants and second aim was to estimate the stability and process ability of the future of rice cultivation in Hungary. For this purpose, we measured the values of consistency by amylograph and calculated the optimal parameters producing rice cakes. The values of consistency demonstrated that the different variety of rice show diversity. First from boiled rice we made traditional boils, called „mochi" and prepared a new cake and baked. Fruit was added, that raised the quality of the flavour. Comparing brown rice and white rice, the tack is similar, but the flavour of the cake is different. Rice can be a good addition to daily diets in particular diseases. The produced goods have similarity in flavour to the Asian products with typical Hungarian characteristics. Rice consumption will be raised most likely, due to its complete value and gluten allergy. The background of rice production can be ensured, and new rice products need to be developed sustainably in the future in Hungary.*

INTRODUCTION

Rice consuming is growing in Europe, even Asian gastronomy encompasses the regional and traditional foods of rice. Rice, *Oryza* L belongs to the Oryzeae trible of the family of Poaceae and contains about twenty species. Rice, *Oryza* L belongs to the Oryzeae trible of the family of Poaceae and contains about twenty species. Nowadays the rice consuming is increasing in all countries because the values of nutrients in rice are favourable from babyhood to elderly age and increasing the gluten allergy.

There are two cultivated species, *Oryza sativa*, Asian rice is the major one; and *Oryza glaberima* is grown in part of West Africa. There are several cultivated and selected or gene modified variants of rice, about 8000 variants. The favourable rice variant for cake is the glutinous rice, *Oryza sativa vary glutinosa* (also called sticky, sweet or waxy rice), growing mainly in southeast and East Asia and the eastern parts of South Asia. The glutinous rice does not contain gluten, which is a special group of protein occurring with starch in the endosperm of various cereal grains (net1). The most cultivated sticky rice variants are the *japonica, indica* and *tropical japonica* strains.

The top rice consuming countries are China, India and Indonesia and the total volume of milled rice produced worldwide reached 496 million metric tons at 2018/19 crop year. Larger than 90% of rice farming in China is irrigated, but relatively small areas being cultivated under rain fed conditions (net2). The osmotic states in plants of rise are important to keep the normal ion uptake (Bernstein L and Hayward 1958, Pan et al 1991). Japan is the only industrialized country whose agriculture based on rice however consumption was 57 kg per capita in last year. The paddy rice production is 3.1 million tons in 450.000 ha within European Union mainly in the Mediterranean countries where 80% in Spain, Italy and 12% in Greece and Portugal, also in France, Romania, Bulgaria and Hungary (net3).

The nutritional effects of rice dishes in childhood, old age and gluten sensitivity are most important and foremost, which is becoming outstanding in our current lives also in the near future. According to the American Heart Association, whole grains improve blood cholesterol levels and reduce the risk of heart disease, stroke, type 2 diabetes, and obesity. Brown rice contains several heart healthy components, such as minerals, antioxidants, lignans, and dietary fiber. Several studies show the effects of ingredients in rice i.e. the selenium content in rice products namely the whole grain rice flour (Urubkov 2021) The dry gluten-free compositions of rice, corn and pseudo-cereals mixture of raw materials were used in the study to determine the amount of selenium (Se) in amaranth flour, unboiled buckwheat groats, whole grain rice flour and corn flour. By mixing the components in a laboratory mixer**,** obtained that the in-rice flour has 135 μg/kg of selenium and the study showed that amaranth, buckwheat and corn are rich sources of selenium (515 μg/kg, 405 and 458 μg/kg, respectively). The mixture of these flours had ranged from 258 to 522 μg/kg of Se. Regular inclusion of rice and amaranth-based foods in the diet of children with gluten intolerance can positively affect the elimination of selenium deficiency.

Hungary had some rice production starting from the 14th century and elevated the production of rice with quality which means the white, brown rice and bio-rice products from 2010 (net4). The corporation of Nagykun 2000 Ltd. has a largest rice field 3000 ha around Kisujszallas in Hungary with different rice products from several rice variants (net5) from 2009 and disposes the instruments (from Zanotti, Italy and Stake, Japan) for producing high-yielding seeds of different rice from 2009 years. They are operated a strict Food Safety System, name ISO 22000, and this resulted constant products of rice seeds as well as rice flours. They have an international cooperation with Mediterranean countries.

The ingredients of raw rice are carbohydrates 79%, fat 0.6%, protein 7% vitamins with macro- and micro elements about 1.5% and water 13% generally (net1). These components of rice quality are defined by the EU "Regulation on the common organization of the market in rice" (Council regulation No. 1785/2003). The consumption of rice in the EU is increasing 6% per year.

However, the supply and demand are not sufficient on the market in Hungary. In daily nutrition only few types of rice products offered in the shopping area.

The first aim of this study was to shape up a new rice cake with fruits from rice cultivated in Hungarian and measured the values of consistency by amylograph and calculated the optimal parameters for producing rice cakes. We also aimed to follow the development of rice cultivation, the industrial development and marketing in the present and future opportunities.

MATERIAL AND METHODS

Rice variants for study:

The rice was transport from Nagykun 2000 Ltd or purchased (Fig. 1), (net5). We are grinded the white rice type A and B, and brown rice type A. (as a BL55). It was purchased the glutinous type B rice in Real or SPAR markets.

Handmade "mochi"

First, we boiled the white rice in water. Dried apricot was purchased in the shop and it was cut for small pieces. Then we formed small balls, ploughed up by perch, and put some apricots into the rice ball and cover with rice powder to eat fresh. This is the cake in New Year event in Japan.

Measuring consistency of rice flour

To compare different curing functional parameters for brown and white rice and brown rice cake with fruits. For this purpose, we measured the values of consistency by Brabender amilograph (Germany) and calculated the optimal parameters producing rice cakes long tenability. Analysis was completed with Excel program.

Fig. 1: Rice field and products of different rice type A and B in Nagykun 2000 Ltd.

Small cake with rice

First the white rice (100%) or brown rice and white rice was mix and heat up slow and do the ball. Than the white rice powder or brown rice and white rice was mix and cooked in water. Dried fruit was purchased in the shop. Than we formed the balls, ploughed up by perch, finally we rolled and stretched until became thickness. The pastry was jagged and formed to moon or heart shaped. Cakes were dried in the oven.

RESULTS AND DISCUSSION

The values of consistency demonstrated that the different variety of rice, most of them between the brown and white polished rice powder show diversity. The white B-type rice-flour or white B-type rice-flour mixed with brown A-type of rice-flour is gave the best products of rice cake. The size of ground rice powder determined the consistency of cake, and the diameter of rice flour was measured. The optimal parameters were calculated from measured consistency curves, the actual temperature (T_{min} and T_{max}), and used for shaping the rice products, the pastry with apricots of mixed the white and brown rice flours. We are able to determine both the beginning and end of the process in swelling.

Fig. 2: Rice cakes from Hungarian cultivated rice:
A) Mochi is cooked rice cake, B) Dried rice cakes

Fig. 3: Rice cake was boiled and dried from the white and brown rice mixture.

First from boiled rice we made traditional dumplings, called „mochi" (Fig. 2A) that those have to be consumed fresh. Then we restructured and made a figural cake with fruits that made a delicious cake after baking (Figure 3). Dried apricot was added, that raised the quality of the flavour. Comparing brown rice and white rice, the tack is similar, but the flavour of the cake is different. The tack tendency of rice type A and type B is rather similar, but type B rice from SPAR is more glutinous, that can be credited to the different amount of starch. More differences were found among the different variants of rice species type, in the measured consistence, as we found in our amilograph measuring. Adding dried fruits will raise the vitamin content and the quality of the flavour.

We live in the age of fourth industrial revolution with the spread of digitalization. Multinational companies established of the cooperation with the other members of the global value chain.

Figure 4. Rice harvesting on the rice fields in Kisújszállás and Milling the rice at 2020 Novembre (Foto from Nagykun 2000 LTD).

HISTORY OF RICE BREEDING IN HUNGARY

Because of the world's population is expanding rapidly, needs all new techniques for crop improvement must be utilized to meet the food demands of the next century. However, the conventional breeding techniques have considerably increased the productivity of modern crops; the application of advanced molecular technologies could speed up further crop improvement. In Szeged and most of the countries use of biotechnology, such as the various tissue-culture methods and gene-transfer techniques now available, could significantly shorten the breeding process, and overcome some of the substantial agronomic and environmental problems that have not been solved using conventional methods. In Hungary the Rice Laboratory of Cereal Research Non-profit LTD in Szeged is active to study from genes to develop a new type of rice as well as different cereals. The following plant species are improved at the Company: winter and spring wheat, durum wheat, rice, winter and spring barley, triticale, oats, rye, corn (grain and silage), grain and silage sorghum, Sudan grass, sunflower, winter rapeseed, soybean, linseed, millet, red clover, Hungarian millet and buckwheat. (net6) Since September 2013 it has been operating with unchanged research profile as a state-owned, self-financing non-profit ltd. under the supervision of the Ministry of Agriculture and belonging to the network supervised by the Centre of the National Agrarian Research and

Innovation (NAIK). The grain researcher is already widely known in Hungary; from abroad we have a keen interest in our seeds. Expanding our trade beyond our borders will also be an important task in the future.

The rice fields in Szarvas at the latest century to produce as much rice as possible at our home. They have about 250 varieties in the gene bank, but we can also buy rice from the fields around Szarvas. The Irrigation and Water Management Research Institute of the National Centre (NAIK) for Agricultural Research and Innovation has been working for the latest decades to create more resistant varieties of rice, There had rice breeding for six decades in the last 50 years. The climate has changed just so much in Hungary that it has become more suitable for rice. Rice is damaged under 10 degrees, so it is got good weather from April to September here. We are now working to create more resistant varieties to the cold and drought rice, told Mihaly Jancso (net7). Until now 25 varieties of rice have been produced here, five of which are currently acknowledged by the government.

RICE FIELDS IN HUNGARY

From the time of Turkish conquest, at XIV century, there is physical evidence of the earliest rice production in the area of Eger town in Hungary (net7).

Hungary lies on the northern border of rice production the protection of the Carpathians provides the right climate and good soils in the Hungarian Plain.

The largest rice producing countries in Europe are Italy, Spain and France, but the 'newcomer' Hungary supplies the EU markets with top quality rice 50% of which comes from Nagykun 2000 Agronomic LTD in Kisújszállás (net 5).

Other companies are able to produce high quality of rice like 'Csárdaszállási Agrarian Zrt'and 'Tarcsai Agrarian Zrt', producing 300 ha white rice and *Oryza sativa subsp. indica* in 100 ha. The average rice yield is about 45 q/ year near the River Körös (net7, net8).

The second largest producer is the Csárdaszállási Agrarian Zrt in Hungary. They produce rise in 600- 700 ha including 30 ha bio-rice field. In 2018 the product was 9.2 t/ha on a table.

Figure 5. The second largest producer is the Csárdaszállási Agrarian Zrt in Hungary (net7).

About half of the production areas are located in the county of Jász-Nagykun-Szolnok, including in the area of Kisújszállás and Meztúr. The other half is located in Békés County, on the border of Szarvas, Csárdaszállás, Köröstarcsa and Békés settlements. Also there is the Vereckei Kft, producing *Oryza sativa subsp. Fruzsina M* and *Ricely* (net8) in rice fields around Szarvas and Mezőberény in Hungary.

CONCLUSION

In Hungary we are able to produce top quality rice and supplied the own country also supplied the EU markets with top quality rice about 50% of which comes from Nagykun 2000 Agrarian Zrt. (Nagykun Mezőgazdasági Zrt).

Rice with fruits, as a little acidic taste may be a good addition to daily diets in particular diseases (net6). From the cooked rise was made dried rice cake flavouring with dried additional taste resulting valuable cake and able to store for longer time.

To go further, we can add other additives to get cake with light structure and packed in suitable way.

The produced goods have similarity in flavour to the Asian products, still with typical Hungarian characteristics.

Rice consumption, as a cereal, will be raised most likely, due to the complete values of ingredients in rice and gluten allergy.

The quality of the Hungarian rice is evenly ensured, it is acknowledged with because it is present on the international European market.

ACKNOWLEDGEMENT: Our project and the colleagues of our institute were highly supported by Nagykun 2000 Ltd. with products and valuable advice of Gyula Fazekas and Janosné Egyed. This work was supported by the projects NKFIH-112688, OTKA K112688 and EFOP-3.6.2-16-2017-00009.

References

Bernstein, Leon and Hayward H.E. *Physiology of salt tolerance*. Annual Review of Plant Physiology, 9:25-43 1958.

Dane F and Meric, C. *Cytological and embryological studies of antherin rice (Oryza sativa vs. 'Rocca'*. Acta Botanica Hungarica 47(3-4): 257-368, 2005.

Darlington, C….D., and Janaki Ammal, E…K. *Chromosome atlas of cultivated plants*, pp 351-352, edited by George, Allen, and Unwin Ltd., London.

Khush, G.S. and Kinoshita, T. *Rice karyotype, marker genes, and linkage groups.* In: eds. by Kush, G.S. and Toeniessen, G.H.: Rice Biotechnology. Manila, pp. 83-108, 1991

Pan R.C., Zheng S.C., Mo S.G. *Influence of Paclobutrazol on mineral element content of rice seedlings.* J. of Plant Nutrition 14:1-7. 1991.

Urubkov SA, Khovanskaya SS, Smirnov SS. *Selenium content in gluten-free products.* Vopr Pitan.;90(1):102-107, 2021. doi: 10.33029/0042-8833-2021-90-1-102-107. Epub 2021 Jan 20. Russian, 2021.

https://en.wikipedia.org/wiki/Japanese_rice

https://nipunarice.com/rice-o-pedia/major-rice-producing-nations/

http://ricepedia.org/rice-around-the-world/europe

https://www.google.com/search?q=rice+production+in+Hungary&rlz=1C1CHFX_huHU662HU662&oq=rice+production+in+Hungary&aqs=chrome..69i57.10898j0j1&sourceid=chrome&ie=UTF-8

https://nagykun.hu/en/rice-cultivation/

https://www.gabonakutato.hu/,
https://www.gabonakutato.hu/uploads/brochure/5d550d0af3aaf169807468.pdf,
https://en.wikipedia.org/wiki/Gluten
https://www.magro.hu/agrarhirek/sikeres-a-rizstermesztes-bekes-megyeben-videokkal/,

https://www.facebook.com/permalink.php?id=1043282119102059&story_fbid=1251087854988150

https://www.borsonline.hu/aktualis/noi-neveket-kap-a-bekesben-nemesitett-rizs/170094
Unwin Ltd., London, 1945.

NOTES ON THE AUTHORS

Correspondence: Dr. habil. Viktoria Szuts*, E-mail: szutsvik@hotmail.com, Department of Food and Engineering, Faculty of Engineer, University of Szeged, Szeged, Hu, and Institute of Plant Biology, Biological Research Centre (BRC) Szeged, Hungary.

Dr. habil Jozsef Gal, galj@mk.u-szeged.hu; Dep. of Engineering Management and Economics Faculty of Engineering University of Szeged, Hungary,

Dr. Kitti Berces MD. University of Szeged, Hungary, University of Szeged, Hungary:

Prof.Dr. Veha, Antal, veha@mk.u-szeged.hu;

Dr.habil. Balazs P. Szabo, szpb@mk.u-szeged.hu;

Bakos, Tiborne, bakosne@mk.u-szeged.hu;

Dr. habil. Jozsef Csanadi, csanadi@mk.u-szeged.hu;

Krisztina Gajdan, gajdan@mk.u-szeged.hu; Zoltan Kertai, kertai@mk.u-szeged.hu;

Students, University of Szeged: Balog-Vig, Fanny; Ormódi, B.Marton.; Szabo, Vivien; Tasnady, Dora; Varga, Eniko.

Dr. Ferenc Otvos, otvos.ferenc@brc,hu; BRC, Szeged, Hungary.

Gyula Fazekas trade manager in Nagykun 2000 Corporation, Kisujszallas, Hungary; E-mail: info@nagykun.hu.