

## MILLET FLOUR ADDITION IMPROVES THE QUALITY OF THE GLUTEN-FREE BREADS BASED ON RICE FLOURS

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### ABSTRACT

The aim of the present study was to assess the possibility of obtaining high quality gluten-free bread using composite flours consisting of three different varieties of rice grain flours in admixture with millet flour. Fifteen composite flours were obtained and tested by mixing the flours of the long, round and medium rice grain with different amounts of millet flour (10-50%). Bread samples were obtained out of dough prepared through the one-stage method. The results of the specific volume of the bread samples indicated that the composite flours based on rice flours obtained by milling long and round grains allowed obtaining higher quality final products. The most promising results in terms of firmness of the bread crumb after 24 hours of storage were obtained in case of samples prepared with long or round grain rice flours supplemented with 20-30% millet flour.

### INTRODUCTION

Rice flour is the main ingredient used for preparing gluten-free bakery products. Trying to compensate for the low content of biologically active compounds, different attempts have been made to obtain composite flours, by mixing it with different other whole grain flours. In this respect Fu et al. (2020) reported that the content of vitamin B2 can be up to ten times higher in millet flour compared to the rice flour, whereas the contents of calcium and iron are seven times higher. Moreover, millet has been reported to have high amounts of phenolic acids and flavonoids. Devi et al. (2014) mentioned the presence of ferulic acid, p-coumaric acid, syringic acid, caffeic acid, syringic acid, and some flavonoids such as quercetin and proanthocyanidins, in millet, which explain the much higher antioxidant activity of millet flour compared to the rice flour.

The aim of the presented study was to compare the bread making behaviour

of three different types of rice flours obtained by milling the long, round and medium rice grains (*indica*, *japonica* and *italica*, respectively) in admixture with wholegrain millet flour. Composite flours were obtained by mixing the different rice flour with various amounts of millet flour (10-50%). The composite flours were further used for preparing breads by means of the one-stage method. The quality of the final products was assessed based on the specific volume and crumb texture.

### MATERIALS AND METHODS

Three commercial rice samples (Riceland Magyarorszag Kft distributed by Herba Rice Mills Rom SRL) – *indica* (long grain), *japonica* (round grain) and *italica* (medium grain) were purchased from the local market (Galati, Romania). The rice samples were processed through grinding using a laboratory disc mill (type WZ-2, Sadkiewicz Instruments, Poland), such as to obtain long grain (RFL), round grain

(RFR) and medium grain (RFM) flours with particle size lower than 400  $\mu\text{m}$ .

The foxtail millet flour (MF) distributed by La Finestra sul Cielo (Villareggia, Italy) was purchased from the local market (Galati, Romania).

The baking test was performed as described by Banu et al. (2010). In short, a laboratory mixer was used to prepare the dough using the one-stage method. After proofing at 30°C, the dough pieces were placed in baking trays and were baked at 230°C for 30 min. The samples were further cooled down to room temperature and the specific volume ( $\text{cm}^3/100\text{ g}$  of bread) was measured using the SR 91/2007 methods (ASRO, 2008). In agreement with the method described by Banu et al. (2017), the firmness of the crumb was determined as the maximum compression force needed to penetrate for 25-mm-wide the bread slices using the ML-FTA system (Guss, Strand, South Africa) with FTA Win control program.

## RESULTS AND DISCUSSION

The best baking behaviour in terms of specific volume was observed for samples prepared with round rice flour (RFR), followed by medium grain flour (RFM) and then by the long grain rice flour (RFL). Specific volume is one of the most important parameters used for assessing quality of bread (Turkut et al., 2016).

The result presented in Figure 1a indicated that, in case of the RFL based samples, the highest specific volume was obtained in case of the bread prepared with 30% millet flour. Further increase of the millet flour addition result in the slight decrease of the specific volume, suggesting that the best composite flour based on RFL includes 30% MF.

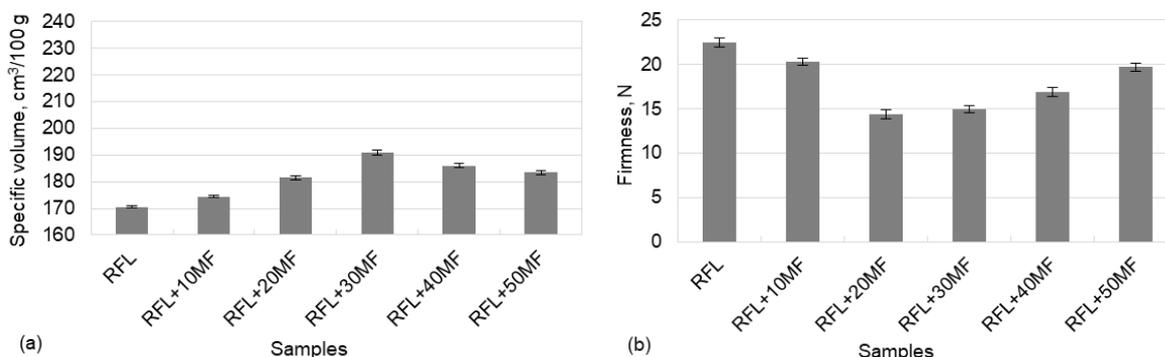
In case of the bread samples prepared with RFR (Figure 2a) and RFM (Figure 3a), it was noticed that the increase of the millet flour percentage from 10 to 50% resulted in significant

increase of the specific volume. In particular, the specific volume of the RFL based samples increased from 208  $\text{cm}^3/100\text{ g}$  of bread, corresponding to the control samples (prepared without millet flour addition) to 237  $\text{cm}^3/100\text{ g}$  of bread, corresponding to the sample including 50% millet flour. Similarly, in case of the samples including RFM, the specific volume increased from 189  $\text{cm}^3/100\text{ g}$  of bread (control samples) to 218  $\text{cm}^3/100\text{ g}$  of bread (samples with 50% millet flour). The improvement of the specific volume of the bread samples with the increase of millet flour might be explained by the high amount of the water soluble pentosanes found in millet flour (Nemeth et al., 2019). Anyway, these results are lower compared to those found by Bender et al. (2019), who reported specific volume of 2.60  $\text{cm}^3/\text{g}$  for the gluten-free breads based on buckwheat flour baked using a conventional oven, and even higher values, ranging from 2.86 to 3.44  $\text{cm}^3/\text{g}$  for bread samples prepared though uniform rapid baking using ohmic heating. Our results in terms of specific volume fall within the range of 1.2 -3.1  $\text{ml/g}$  reported by Wu et al. (2019) for the rice flour gluten-free breads. They showed that the specific volume of the rice flour breads and the firmness of the hardness were affected by the increase of the starch damage content. Our observations comply with Foste et al. (2014) who obtained a significant improvement of the volume of the bread by replacing rice and corn flour by 40% whole grain quinoa flour.

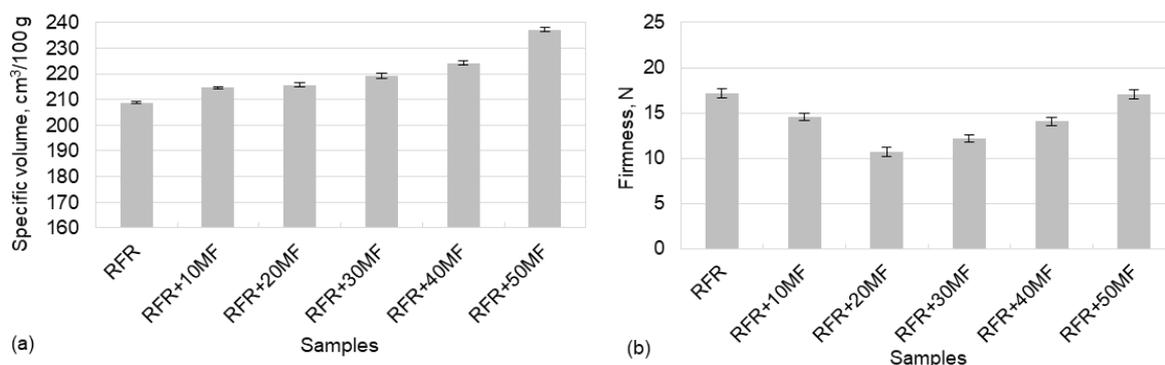
The analysis of the crumb firmness indicated that, regardless of millet flour addition bread samples based on RFL (Figure 1b) had higher crumb firmness compared to the corresponding bread samples based RFR (Figure 2b) or RFM (Figure 3b). The composite flours based on RFL having the best baking properties are those including 20% MF. In a similar manner the addition of 20-30% MF to RFR or RFM resulted in improving the bread crumb firmness compared to the corresponding control samples (Figures

2b and 3b). Even if further increase of the MF addition within mixtures up to 50% resulted in the increase of the bread samples texture, it should be anyway noted that, firmness of the breads

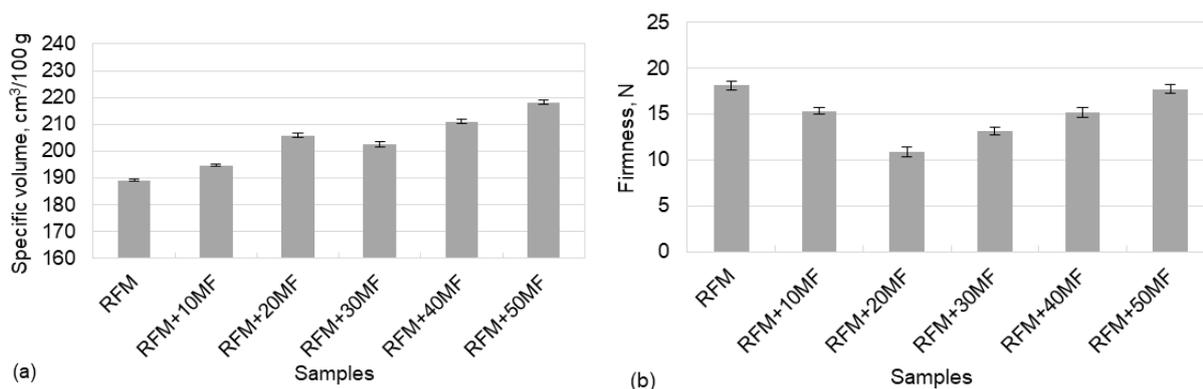
prepared with 50% RFR or RFM and 50% MF was lower compared to the firmness of the bread including 90% RFL and 10% MF.



**Figure 1. Specific volume (a) and crumb firmness (b) of bread samples obtained with rice flour from long grain (RFL) mixed with 10-50% millet flour (MF)**



**Figure 2. Specific volume (a) and crumb firmness (b) of bread samples obtained with rice flour from round grain (RFR) mixed with 10-50% millet flour (MF)**



**Figure 3. Specific volume (a) and crumb firmness (b) of bread samples obtained with rice flour from medium grain (RFM) mixed with 10-50% millet flour (MF)**

Overall, considering both the results of the specific volume of the bread and the firmness of the bread crumb (Figures 1-3) one can observe that the rice flour obtained by grinding the round and

medium rice grains have better breadmaking properties compared to the flour obtained from the long rice grains.

## CONCLUSIONS

The results of the present study indicated the possibility to improve the baking properties of the rice flours from different varieties by mixing it with millet flour. The gluten-free breads prepared using this kind of composite flours were characterised in terms of specific volume and crumb firmness. Based on the characteristics of the gluten-free bread samples it was concluded that the flour from round rice grains and medium rice grains have better bread making properties compared to the flour from long rice grains. The best results in terms of crumb firmness were obtained for samples prepared with flour from long rice grains mixed with 20-30% millet flour, and with flour from medium or round rice grains mixed with 30% millet flour.

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