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MIXING AND PASTING CHARACTERISTICS OF THE PUMPKIN SEEDS-WHEAT FLOUR BLENDS

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Abstract

Due to it high nutritional and sensorial characteristics of pumpkin seed flour (PSF) it is suistanable to be used as ingredient in different food products such as cereal products. The objective of this study was to analyze the effect of PSF addition (from 0% up to 20%) in a meal form (PSF) in a refined wheat flour on the mixing dough rheological properties by using Farinograph and Extensograph devices and pasting dough rheological properties by using Amylograph and Falling Number devices. It seems that by PSF addition the water absorption capacity increased, whereas compared to the control sample the dough stability and development time decreased. According to Extensograph device the dough extensibility decreased with the increased level of PSF addition in wheat flour. The dough pasting properties showed that by PSF addition the Falling Number and peak viscosity decreased whereas the gelatinization temperature and temperature at peak viscosity increased.

Key words*: wheat flour, pumpkin seeds, Farinograph, Extensograph, Amylograph, Falling Number.*

INTRODUCTION

The pumpkin belongs to the family *Cucurbitaceae,* genus *Curcubita*. The nutritional value of pumpkin seeds are high (Xanthopoulou *et al.,* 2009) those containing 37-46% proteins, 25-37% fat content, 16-24% dietary fibers and arround 4.5% minerals (Mironeasa and Codină, 2016). These seeds are rich in sources of unsaturated fatty acids (especially linoleic and oleic acids), vitamins (vitamin E and the main isomers alpha-tocopherol and gamma-tocopherol), minerals, phytosterols, pigments, pyrazine derivatives and phenolic compounds (Murković *et al.*, 2000; Xanthopoulou *et al.,* 2009). Its fibers content contains 40% cellulose, arround 4% hemicellulose and 4% lignin. Along its high nutritional value pumpkin seeds presents a highly desired aromas, sweetness taste and greenish color (Mirhosseini *et al.,* 2015).

Due to it high nutritional and pleasant sensorial characteristics pumpkin seed flour (PSF) may be used as ingredient in different food products. In cereal products, PSF may be used as ingredient in order to improve the nutritional, physical and sensory qualities of bakery products. It was reported that it was used as ingredient in different cereal products such as: breads, cakes, instant noodles and spices, as well as a natural coloring agent in flour and flour mixtures (Hosseini, *et al.,* 2018; Minarovičová *et al.,* 2017).

Different studies reported that up to a certain level PSF addition may improve bread quality from the sensory and technological point of view. Mironeasa and Codină (2016) concluded that up to 10% PSF addition was obtained bread of a good quality. El-Soukkary et al. (2001) reported that the addition of pumpkin seeds leads to an acceptable bread quality up to 17% for raw, roasted and autoclaved meal forms, up to 19% for germinated, fermented and pumpkin protein concentrate forms and up to 21% for pumpkin protein isolate form. An increase of bread volume and the scores for organoleptic acceptability has also been reported by Ptitchkina, *et al.* (1998) which added pumpkin powder in wheat flour and by Jeevitha and Bhuvana (2019) which concluded that pumpkin seed meal can be added to the whole wheat bread in order to improve the nutritional value and the physical properties of the bread even at high levels. However, Dabash, *et al.* (2017) did not

reported any significant improvement of bread quality by PSF addition in wheat flour. They concluded that, in general, the increase of the amount of PSF addition in wheat flour conducted to an decrease to the specific volume of bread and it sensory acceptabiliy.
Thus, the addition of PSF influenced bread quality and therefore the technological properties of bread making. With the addition of PSF, the baking loss decreased with 9.18% compared to the control bread (Jeevitha and Bhuvana, 2019). El-Soukkary (2001) reported an increased of the water absorption, dough development time and softening values with the increase level of PSF addition whereas Costa *et al.* (2018) reported an decreased of water absorption, stability and dough development time values for the samples in which pumpkin seeds with high fat content were incorporated in wheat flour. It seems that this different results obtained by different reserchers are due to the type and level of PSF used in wheat flour. Many studies are focused on using pumpkin seeds after drying and grinding the meal or seeds (El-Demery, 2011) others are focused on using PSF in a grounded form (Mironeasa and Codină, 2016) under germinated and fermented form, under concentrate and isolate protein form, e.g (El-Soukkary, 2001).
The objective of this study was to analyze the effect of pumpkin seed addition (from 0% up to 20%) in a meal form (PSF) in a refined wheat flour on the mixing and pasting dough rheological properties.

MATERIALS AND METHODS

Commercial wheat flour (harvest of 2019) from S.C. MOPAN S.A. (Suceava, Romania) and partially deffated pumpkin seed flour (Marbacher Ölmühle GmbH, Germany) was used. The flours were analyzed according to ICC methods as: ash content (ICC 104/1), moisture content (ICC methods 110/1), protein content (ICC 105/2). The wheat flour was also analyzed through the international and Romanian standard methods: falling number (ICC 107/1), wet gluten (SR 90:2007) and gluten deformation index (SR 90:2007).
Dough rheological properties during mixing were analyzed using the devices Farinograph (Brabender OGH, Duisburg, Germany with a 300 g capacity) and Extensograph (Brabender OGH, Duisburg, Germany) according to ICC method 115/1.
Dough rheological properties during pasting were analyzed using the devices Amylograph (Brabender OGH, Duisburg, Germany) according to ICC method 126/1 and Falling Number (Perten Instruments, Sweden) according to ICC method 107/1.
Statistical analysis was performed with XLSTAT (Version 2019.14.1, free trial; Addinsfot's Corporation, USA). Results are presented as means±standard deviation. An ANOVA and Tukey tests were performed with a 95% confidence interval.

RESULTS AND DISCUSSIONS

The wheat flour analytical characteristics are the fallowings: 0.65% ash content, 14.0% moisture content, 12.67% protein content, 30% wet gluten content, 6 mm gluten deformation index, 1.5% fat content and 442 s Falling Number value. According to the results obtained the wheat flour is a very good one for bread making with a low α amylase activity. The PSF presented the fallowing characteristics: 29.7% ash content, 5.68% moisture content, 62.27% protein content and 10.81 fat content.
According to Farinograph measurements shown in the Figure 1 the PSF addition in wheat flour significantly increased ($p < 0.05$) the water absortion (WA) value up to 4.2% to the PSF20 sample compared to the control one. These results are in agreement with those reported by El-Soukkary (2001), Costa *et al.* (2018) for dough samples in which pumpkin seeds flours in a defatted form were incorporated in wheat flour. This may be attributed to the high protein content of pumpkin seeds flour which absorbs water in the dough system limiting the water availability for the gluten network development. The dough development time (DDT) and dough stability (ST) increased from 1.9 to 7.7 and 2.3 to 11.0 respectively and further decreased when high levels of PSF were incorporated in dough samples. Also the degree of softening at 10 min (DS) decreased and at high levels begin to increased due to the gluten dilution by PSF

addition, a non gluten flour in wheat flour as it may be seen in Figure 2.

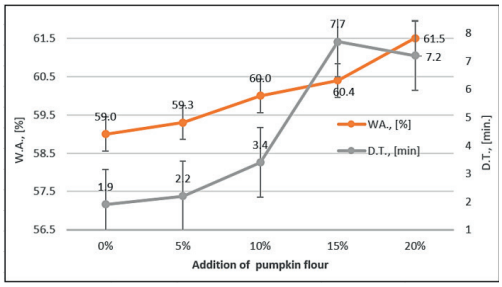

Figure 1. Farinograph water absorption (WA) and dough development time (DT) parameters of pumpkin seeds-wheat flour blends

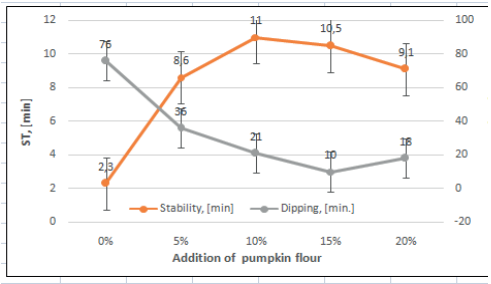

Figure 2. Farinograph stability (ST) and degree of softening (DS) parameters of pumpkin seeds-wheat flour blends

Dough extensibility for the samples with different levels of PSF addition is shown in Figures 3-6.

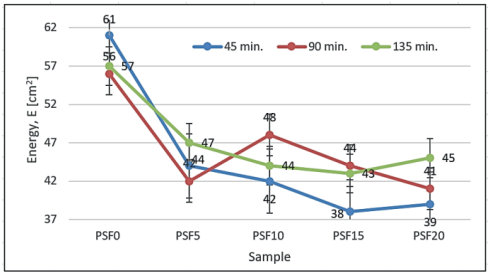

Figure 3. Extensograph energy (E) parameter of pumpkin seeds-wheat flour blends

As it may be seen compared to the control sample the Extensograph parameters decreased probably due to the fact that PSF decreased the gluten availability which affect the development of three-dimensional dough structure. According to El-Soukkary, (2001) and Sundy, (2004) which obtained similar data for dough samples with PSF addition the dough weakening may be due to the following reasonns: gluten dilution, the presence of sulphhydryl groups from PSF, the competition between proteins of wheat flour and PSF for water. The pumpkin seeds-wheat flour blends presented a ratio number higher than the recommended values of 1.2 facts that make the use of these blends feasible in bread making.

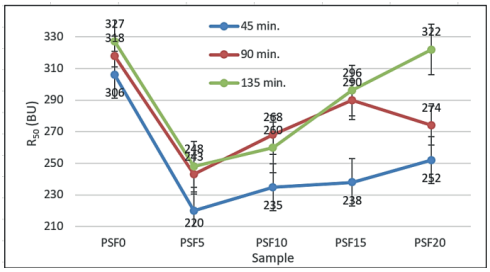

Figure 4. Extensograph resistance to extension (R_{50}) parameter of pumpkin seeds-wheat flour blends

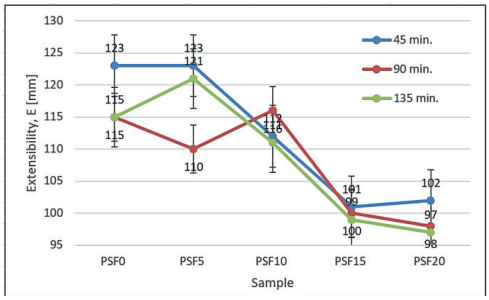

Figure 5. Extensograph extensibility (E) parameter of pumpkin seeds-wheat flour blends

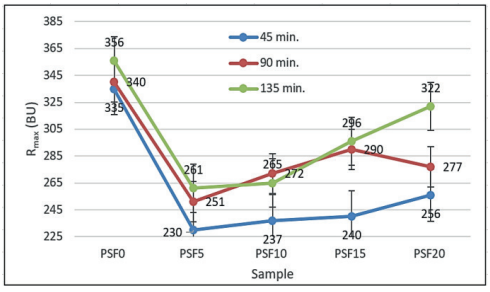

Figure 6. Extensograph maximum resistance to extension (R_{max}) parameter of pumpkin seeds-wheat flour blends

The pasting characteristics of pumpkin seeds-wheat flour blends are shown in Figure 7 and Figure 8.

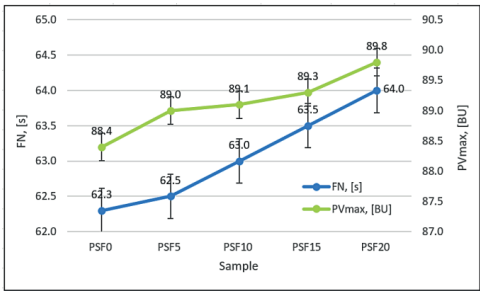

Figure 7. Falling Number value and Amylograph peak viscosity (PV_{max}) parameter of pumpkin seeds-wheat flour blends

The falling number value of wheat flour dough decreased with the increased level of PSF addition, showing a decrease in dough viscosity of the blends. These data are in agreement with those obtained by Khan *et al.* (2019) which also has been reported an decreased of FN with pumpkin seed flour addition.

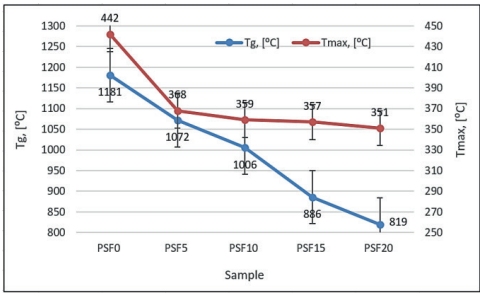

Figure 8. Amyograph gelatinization temperature (Tg,) and temperature at peak viscosity (T_{max}) parameters of pumpkin seeds-wheat flour blends

According to the Amylograph data, the gelatinization temperature increased ($p < 0.05$) with the increased level of PSF addition indicating a delay of starch gelatinization, these data being in agreement with those obtained by Wongsagonsup, *et al.* (2015) regarding final RVA pasting temperature for wheat flour in which PSF was incorporated. Also the temperature at peak viscosity had a similar trend with the gelatinization temperature values which increased when PSF were incorporated in wheat flour dough.

Regarding the peak viscosity, these values were significantly decreased ($p < 0.001$) when PSF were incorporated in wheat flour. This decreased with the increase level of PSF addition may be attributed to lower starch content from the pumpkin seeds-wheat flour blends. As the addition level of PSF in wheat flour increased, the non-starch component from the dough system decreased, leading to a decrease of the PV_{max} when temperature increased above the starch gelatinization. According to Wongsagonsup, *et al.* (2015) the lower peak viscosity for samples with PSF addition are due to higher lipid content of PSF and less nitrogen-free extractives (mainly starch) from it. They explain the undetectable breakdown of pumpkin seeds-wheat flour blends to the swelling restriction of starch by lipids fact that causes a stronger structure of starch granules. When helical complexes develop between starch chains and lipids, the helices hold amylopectin and amylose molecules together, which restrict granule swelling fact that will led to an increase in pasting temperature, and in a decrease in the pumpkin seeds-wheat flour blends viscosity and increase resistance to shear-thinning of paste.

CONCLUSIONS

By using the PSF up to 20% level addition in wheat flour of a low α amylase activity and a very good quality for bread making according to the wheat flour analytical data, the dough rheological properties were improved. This fact showed that PSF addition in wheat flour is feasible from rheological point of view in bread making. Therefore the dough stability and development time increased up to 15% PSF addition and dough extensibility decreased with the increased level of PSF incorporated in wheat flour. With the increase temperature of dough samples the dough viscosity decreased showing a decrease in falling number values and peak viscosity.

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