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SOLID STATE FERMENTATION (SSF) OF LUPIN FLOUR IN OBTAINING BAKERY PRODUCTS

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Abstract: *Solid state fermentation (SSF) is an effective method used in the food industry in order to improve the nutritional properties of some products, respectively reducing anti-nutritional properties. This paper investigates the possibility of using Asspergillus sojae fermented lupin flour added in different proportions (10-30%) in obtaining bakery products with increased nutritional attributes. The proximate composition of the bread obtained with lupin flour fermented with Aspergillus sojae showed a higher protein content compared to a similar product obtained from unfermented flour, respectively a lipid intake, mineral substances and total polyphenols more marked by fermentation. The obtained results highlight the possibility of using lupin flour fermented with Aspergillus sojae as a floury matrix with applicability in baking in order to increase the nutritional and functional value of the obtained products.*

Introduction

Lupin (*Lupinus polyphyllus)* is a herbaceous plant in the legume family, Fabaceae, which also includes peas. Lupin is a plant cultivated in the Mediterranean basin as food or as an ornamental flower. It is found on the North and South American continents, as well as in the European and African areas of the Mediterranean [1]. Lupin is a plant that is grown for fodder and green manure. Of the more than 200 species, in addition to all wild varieties, there are also species cultivated for human consumption, others for ornamental value, and most as animal feed. The progress of genetics in the 20th century contributed to the complete domestication of lupin species, by hybridizing those with low alkaloid content and those with soft seeds, giving rise to new, sweet varieties, much more suitable for human consumption [2]. Certain varieties of lupin (Lupinus albus - white lupin, Lupinus luteus - yellow lupin, Lupinus angustifolius - blue lupin) are used in food, especially in the Mediterranean area [3].

- Figure 1. Lupin flowers

Mould strains belonging to the species Aspergillus oryzae and Aspergillus sojae are highly valued as koji molds in the traditional preparation of fermented foods such as miso, sake and shoyu, and as protein production hosts in modern industrial processes. A. oryzae and A. sojae are relatives of the wild molds Aspergillus flavus and Aspergillus parasiticus. All four species are classified in the group A. flavus. Koji mold species are generally perceived as nontoxic, while wild molds are associated with carcinogenic aflatoxins [4].

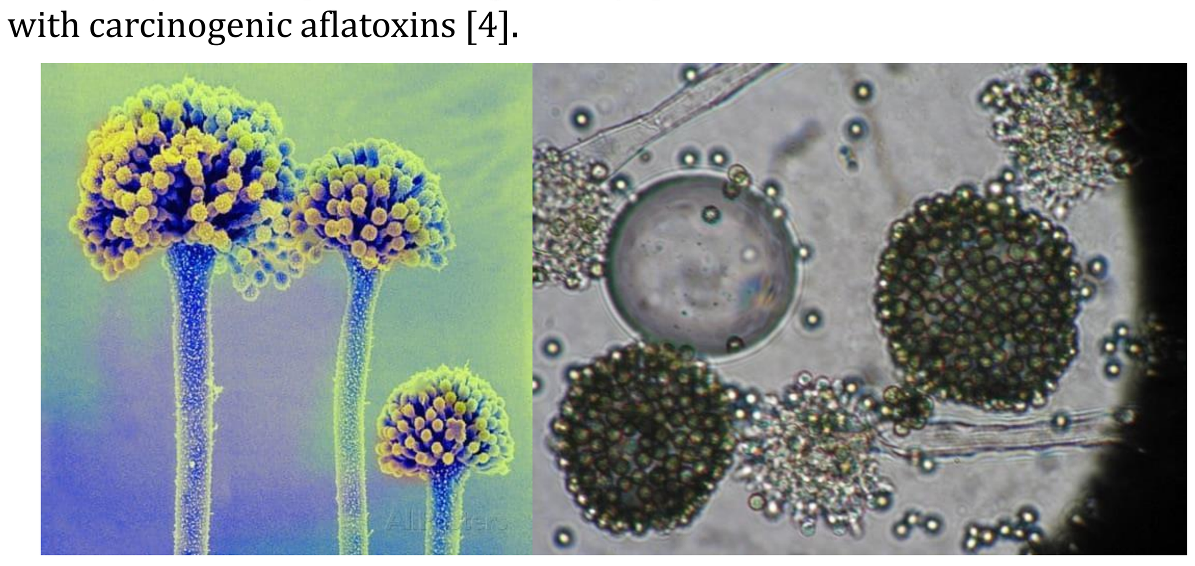

Figure 2. Aspergillus sojae Aspergillus sojae [5]

Material and method

Lupin flour (LF) produced by Dried Fruits Suppliers was purchased from VitaMix40 shop Timisoara, and wheat flour (WF) type 550 from Auchan supermarket Timisoara. Aspergillus sojae were used for fermentation of lupin flour under conditions recommended as optimal for their development. Fermentation was carried out with inoculum in an amount equal to 10% of sample weight and raw material humidity of 60%, in hermetic flasks, incubated at 30 C, until pH reached values in range of 4.0–4.2, for approx. 20–22 h Three types of composite flours were obtained LFAS 1 (10% lupin flour fermented and 90% wheat flour); LFAS 2 (20% lupin flour fermented and 80% wheat flour); LFAS 3 (30% lupin flour fermented and 70% wheat flour). The bread was obtained as is presented in the figure 3.

The proximate composition was analyzed according to ISO Methods: moisture SR 91/2007 pct.10, protein SR EN ISO 8968-1:2014; total lipid SR 91:2007 pct.14.4; mineral substances SR ISO 2171/2010, sugar SR ISO 91-2007 . The total phenolic content (TPC) of composite flours and breads with different percentages of lupin flour was analyzed according to the modified Folin-Ciocâlteu method [12].

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Results and discussions

The results regarding the bread samples fermented with Aspergillus sojae,, picture with the samples ans the technolgical flow are presented in the figures 3-6.

It can be observed significant increase of lupin protein in fortified samples was an effect of fermentation with participation of the Aspergillus sojae. In all samples after fermentation, there were higher amounts than before.

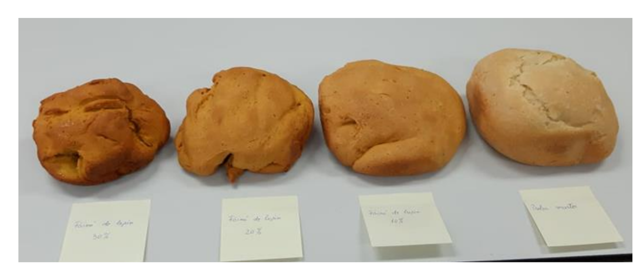

Figure 3. Bread sapmles fermented with Aspergillus sojae

Table 1. Physical parameters of fermented bread

	Volum %	Raport HD	Porozity %	Elasticity %
Control	840	0.535	66.34	95
10%	770	0.477	68.16	91
20%	760	0.45	61.61	81
30%	600	0.535	47.88	72

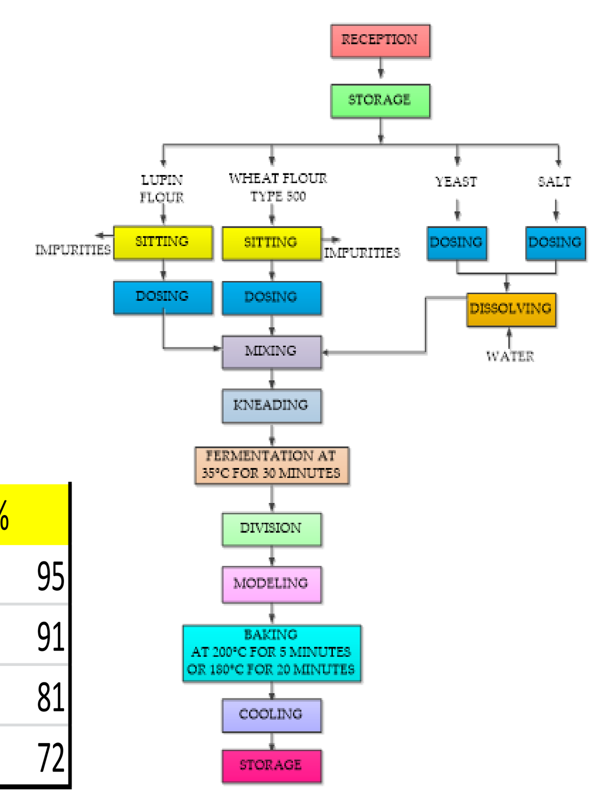

Figure 4. Technological flow of bread making process

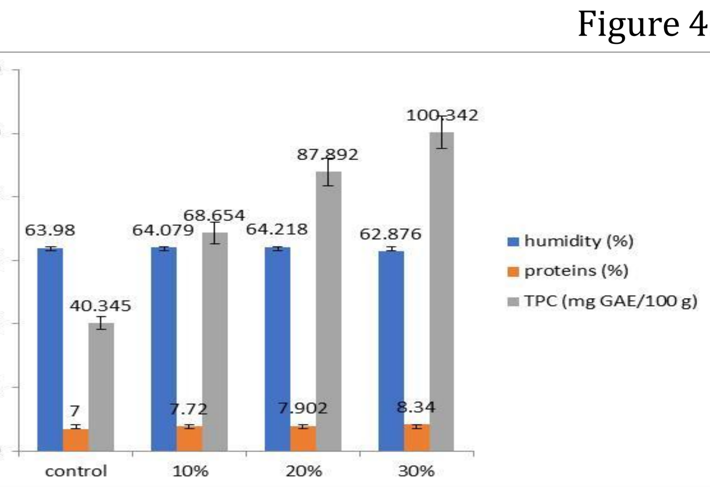

Figure 5. Protein, humidity and TPC of fermented bread

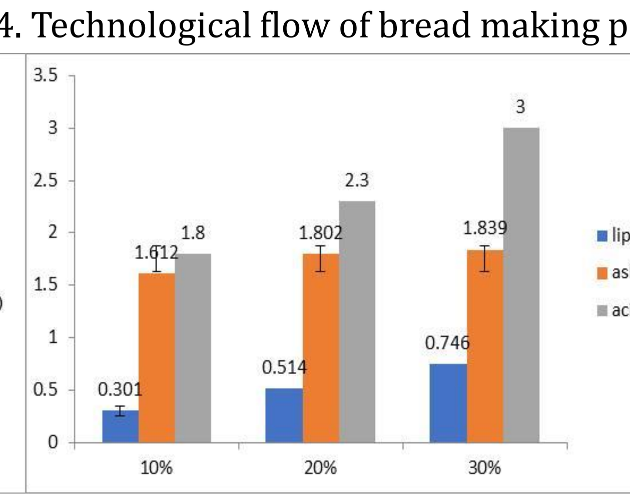

Figure 6. Lipids, ash and acidity of fermented bread

Regarding lipids, mineral substances intake and TPC content, the fermentation improve the bread quality by increasing of lipids and mineral substances level. Opposite, the elasticity and H/D ration of bread decrease by addition of fermented flour, Higher porosity was observed at addition of 10% fermented flour.

Conclusions

The study indicated that SSF of lupin flour with *A. sojae* can improve the nutritional and functional properties of bread,, but some shortcomings in the appearance of bread can be observed. Despite this, solid-state fermented lupin flour is a promising ingredient and can find potential industrial applications in the development of novel functional bakery products.

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