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## ACORN FLOUR – NATURALLY GLUTEN FREE

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### ABSTRACT

Gluten intake causes gastrointestinal disorders in celiac and intolerant patients. The current trend of consuming gluten free products has added to the demand for these industry products. Digestive health reasons, weight management, and nutritive value of these foods are some of the reasons that have been driving the gluten-free products market. Manufacture of gluten-free products requires the use of preselected raw materials. The number of such ingredients is limited; therefore, the acorns could become one major food source and an attractive novel ingredient for the future. The objective of this paper was to perform and document a complete production cycle of acorn flour starting from the foraged tree nuts, collected in October in Slavonia (east Croatia). The results of physical and chemical investigations of differently treated samples of oak acorn are also presented in this paper. Oak acorn, *Quercus robur* L., (belonging to *Fagaceae* family) was investigated in native and thermally treated forms. The acorns were allowed to dry naturally and then shelled. The meal was coarsely ground and dried at 40 °C for 24 h and milled. Produced acorn flour contains 4.56 % fat, 6.48 %, protein, 36.86 % hemicellulose, 14 % cellulose and 1.96 % minerals.

**Keywords:** gluten free products, oak acorn, acorn flour

### INTRODUCTION

For thousands of years acorns, the fruit of oak trees, have been a staple food throughout North America, Asia, the Middle-East, North Africa and Europe (Bainbridge, 2006; Grlić, 2005; S. L. R. L. R. Mason, 2000; Revedin *et al.*, 2010). However, nowadays they have almost disappeared as a food for human consumption. Recent interest in foraging for wild food and increasing environmental awareness, as well as the search for health and wellbeing through balanced nutrition, would also represent a strong argument for inclusion of acorns in cooking. Commercial acorn processing today is mainly limited to countries such as Korea, China and to a lesser extent, the U.S.A. (Bainbridge, 2006).

Besides linking to ancient culinary tradition and foraging, using acorn flour is desirable from a nutritional point of view, because of content of fat (of which over 80 % is unsaturated), proteins and considerable amount of electrolytes (calcium, magnesium, potassium and phosphorus), but little or no sodium, and is rich in iron, copper and zinc. Acorn meal could be a nutritionally functional ingredient in foods that use wheat flour such as cookies, muffins, breads, bars, noodles, pastries, bread and deserts (Sabrin, n.d.) Functional foods are value-added foods that have been shown to have a growing presence in the food industry. Availability of foods that contribute to health benefits and disease prevention is a great tool for nutritionists to employ when trying to improve the eating habits of individual clients and the general population. Acorns have been an important part of traditional diets of people throughout the world and are reported to have potential health benefits (Tadayoni *et al.*, 2015), (Rakić *et al.*, 2006).

The objective of this study was to perform and document a whole production cycle of acorn flour starting from the foraged tree nuts collected in October 2014 by local forestry enterprise from eastern Croatia.

## Materials and Methods

### *Plant Material*

The representative sample used in this investigation was the oak acorn (*Quercus robur* L., which belongs to the *Fagaceae* family). The acorns used to produce the acorn flour were gathered during the second week in October 2014. The collected acorns were inspected in order to remove rotten and infested specimens. Remaining acorns were then allowed to dry naturally by spreading them in a single layer outside on the table during sunny days for approximately 10 days. The acorn flour did not undergo any treatment that would greatly alter the nutritional composition of the acorn, once shelled.

### *Production of Acorn Flour*

After the drying period, acorns were manually shelled with a nutcracker. The skin remaining on the outside of the fruit bodies was then removed by mechanic peeling. The shelled and peeled acorn kernels were roughly ground in a food processor Braun MC1 for 1 minute at speed 2. Grounded kernels were spread evenly onto baking paper and placed in a food dehydrator (Gorenje FDK24DW) for 24 hours at 40 °C. After the drying process was completed the product was placed in a mill and ground into a fine meal (Lab Mill IKA MF10), ready to be used in cooking and baking applications.

## RESULTS AND DISCUSSION

The following is an overview of the results of the analyzed samples of acorn flour.

The breakdown of yields during the processing steps is displayed in Table 1. The yield percentage of flour, after processing from whole acorns to acorn flour, was 54.59 %.

**Table 1.** Product yields during processing

Product	Weight	Percentage of initial total
Acorns Whole	3984 g	100.00 %
Acorns shelled and skinned	2634 g	66.11 %
Acorn flour	2175 g	54.59 %

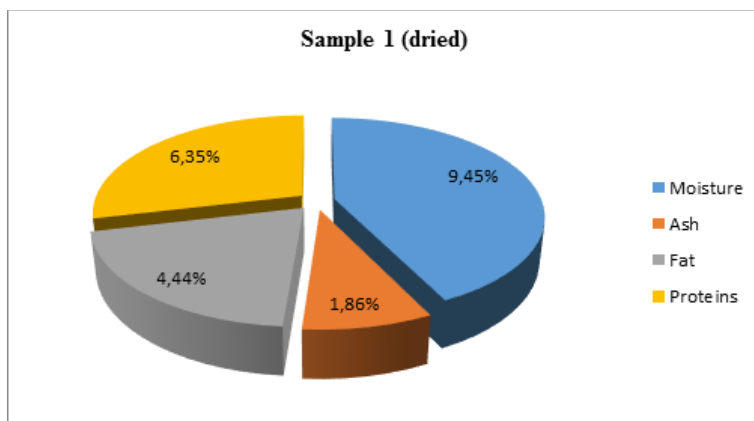
The results of physicochemical analyzes are presented as follows:

**Table 2.** Characteristics of the analyzed samples

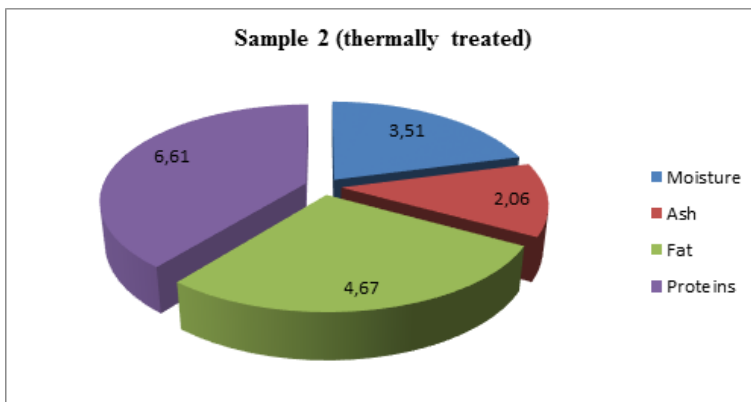
Sample	Treatment	Appearance
Sample 1	Dried and milled nut	Light brown powder
Sample 2	Thermally treated ground nut at 170 °C (10 min)	Brown powder

**Table 3.** Characteristics of the analyzed sample

Sample	Moisture (%)	Ash (%)	Fat (%)	Proteins (%)
Sample 1 (dried)	9.45	1.86	4.44	6.35
Sample 2 (thermally treated)	3.51	2.06	4.67	6.61

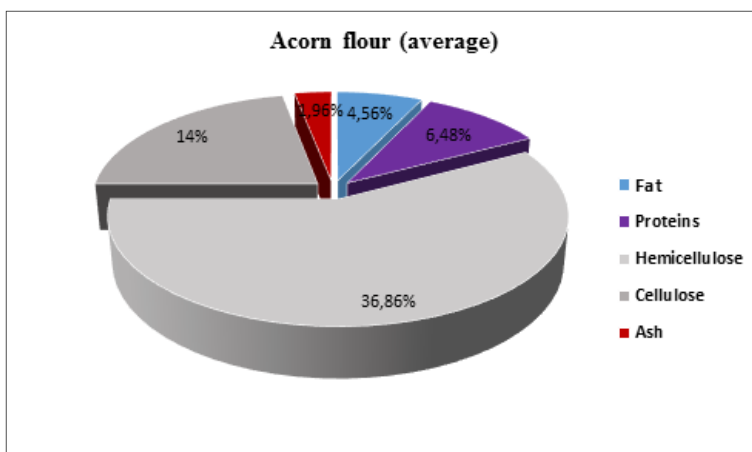


**Figure 1.** Characteristics of the analyzed dried acorn flour



**Figure 2.** Characteristics of the analyzed thermally treated acorn flour

According to the results of physicochemical investigations of differently treated samples of scorn flour (Table 3, Figure 1 and 2) it was possible to conclude that there is no significant difference between row and thermally treated samples of flour in composition of fat, proteins or ash, except of moisture, and appearance. On average, produced acorn flour contains 4.56 % fat, 6.48 % protein, 36.86 % hemicellulose, 14 % cellulose and 1.96 % ash as showed on Figure 3.



**Figure 3.** Characteristics of the analyzed acorn flour (average)

## CONCLUSIONS

Produced pedunculate oak (*Quercus robur* L.) acorn flour contains on average 4.56 % fat, 6.48 % protein, 36.86 %, hemicellulose, 14 % cellulose and 1.96 % ash. There is no significant difference between row and thermally treated samples of flour in composition of fat, proteins or ash, except of moisture. The yield percentage of acorn flour, after processing from whole acorns to acorn flour, was 54.59 %. Finally, acorn flour produced from foraged pedunculate oak acorns is suitable for home production and use in a variety of bakery products.

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