Thalassia Salentina
Thalassia Sal. 43 (2021), 121-126
ISSN 0563-3745, e-ISSN 1591-0725
DOI 10.1285/i15910725v43p121
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EFFECT OF GEOGRAPHIC ORIGIN IN MINERAL COMPOSITION OF ZEEN OAK ACORNS (*QUERCUS CANARIENSIS* WILLD)

SUMMARY

The aim of the current study was to investigate the effect of geographic origin in mineral compositions on the *Q. canariensis* acorns. The results showed that there were significant ($p < 0.5$) differences between populations for macronutrients Sodium (Na), Calcium (Ca), Potassium (K)) except for Phosphorus (P) and for all studied micronutrients: Iron (Fe), Manganese (Mn) and zinc (Zn). Potassuim contents of acorn ranged from 5,638 to 7,667 mg/g MS with highest being for Nefza acorn and lowest for Bni Mtir ones. It is the highest macronutrients for all population. However Iron was the most abandon micronutrient, varied widely from 0,491 mg/g MS (Bni Mtir) to 1,230 mg/g MS (Nefza). No significant differences were recorded for Heavy metal. The concentrations of Chromium (Cr), Nickel (Ni) and Cobalt (Co) in acorns flour are null. On the other hand Cadmium (Cd) and Copper (Cu) were found but with concentrations which were much lower than that the acceptable limits for herbs and spices by WHO.

Keywords: *Quercus canariensis* Willd, Acorns, Mineral composition; population.

INTRODUCTION

The oak zéen (*Quercus canariensis* Willd) which has a remarkable longevity is part of a group of deciduous species distributed around the Mediterranean

and located mainly in the Ibero-Maghreb region (Quézel and Bonin, 1980). In the Iberian Peninsula, it occupies a widely dispersed area including the Catalan coastal chain around Barcelona, the Sierra Morena, southern Portugal and western Andalusia (provinces of Cadiz, Malaga, Seville, Huelva) (Rabhi *et al*. 2011). In North Africa, it occupies 102,000 ha, including 65,000 ha in Algeria (Messaoudène and Tessier, 1991), 20,000 ha in Tunisia and 17,000 ha in Morocco (Tafer, 2000).

Despite its scientific name, this species is not present in the Canary Islands. In Tunisia, it forms two vast massifs, one in Fedja and the other in Ain Draham, their surface is estimated at 20000ha (Tafer, 2000), with some islands in Mogods.

The use of the oak acorn has a long world history in human food, popular medicine, animal feed and tanneries (Lope and Bernardo, 2005; Nieto *et al*., 2002; Kayouli and Buldgen, 2001). Acorn contains compounds, such as essential amino acids, fatty acids, polyphenols, vitamins, and minerals, whose health, nutritional, and functional benefits are well demonstrated (Rakić *et al*., 2006; Cantos *et al*., 2003; Al Rousan *et al*., 2013).

The zeen oak relace tree by sites, even though it is ecologically and economically important, has benefited from only a few very limited studies. The aim of the current study, conducted for the first time in Tunisia, was to characterize four different populations of the *Quercus canariensis* and to evaluate their nutritional appropriateness on the basis of the mineral composition of the acorn flour.

MATERIAL AND METHODS

Plant Material

Mature acorns of *Q. canariensis* were collected from four different relace tree by sites in northern Tunisia (El Ghorra, Bni Mtir, Ain Snoussi, Nefza) in November 2020. Acorns were dried at 40°C and ground for laboratory analysis.

Chemical analysis pathway

The contents of K, Ca, Mg, P, Cu, Mn, Fe, and Zn in the acorn samples were assessed by oxidizing each subsample with a 2 : 1 mixture of nitric and perchloric acid. In separate aliquots, Ca and K were determined by flame photometry, P by spectrophotometric methods (Khalil and Manan, 1990). Concentration of Fe, Mn, Zn, Cu, and Mg were determined by atomic absorption spectrophotometry (AOAC, 1999; method 968.08) (PERKIN ELMER/AA800, PerkinElmer, Inc., San Jose, CA, USA). Each sample was analyzed in triplicate. Macronutrient, microelements and heavy metals concentrations were expressed in mg x g of dry weight.

Statistical analysis

The effect of populations on mineral composition on the *Q. canariensis* acorn flour mineral contents were tested with the GLM procedure (General Linear Models) of the SAS (9.0) program. Mean differences were considered significant at $P<0.05$. All the analyses were made in triplicate.

RESULTS AND DISCUSSION

According to analysis results, acorn flour of *Q. canariensis* had different mineral compositions. Population also affected micro and macro mineral composition of acorn. This may be related to differences in growth conditions of growth, such as soil, bioclimate and water availability, and geographical features such as altitude.

I this context, the impact of altitudinal zone on the nutritional quality in particular mineral compounds of *Quercus coccifera* L. acorns was assessed by Roukos *et al*. 2017. Indeed, in our study, acorns were collected from 4 sites located at different altitudinal zones (lower (Nefza), middle (Bni Mtir and Ain Snoussi), upper (El Ghorra), which could be explains the difference in mineral compositions between the four populations of the zeen oak. Roukos *et al*. (2017) showed that P, Fe, Zn in kermes oak acorns is higher in the lower altitude than the upper one. This result is in agreement with our findings where Nefza population had higher P, Fe and Zn contents in Zeen Oak acorns than El Ghorra population.

The macromineral composition of oak acorn flour is shown in Table 1. Origin geographic had a significant effect on the macro mineral composition of oak acorn flour ($p<0.5$). Potassium (K) contents ranged from 5,638 mg/g DM to 7,667 mg/g DM with highest being for Bni Mtir and lowest for Nefza. Compared by other *Quercus* acorn, the ones of *Q. canariensis* as *Q. aegilops* (Vassiliki et al. 2018), *Quercus robur* (Rakić *et al*., 2006) and *Q. coccifera* (Roukos *et al*., 2017) and Quercus suber (Belghith *et al*., 2015) had higher mineral compositions.

Soduim (Na) and Calcium (Ca) contents were the highest in Bni Mtir population successively (0.942 mg/g DM and 0.007 mg/Kg DM). Na and Ca levels of acorns of the present study were lower than that presented by Rakić *et al*. (2017) for *Q. robur* and by Vassiliki *et al*. (2018) for *Q. aegilops*.

Phosphorus content (P) of oak acorns varied widely from 0,963 to 0,755 mg/g DM with highest being for Nefza population and lowest for El Ghorra one. Phosphorus content of *Q. canariensis* acorns are consistent with finding of Roukos *et al*. (2017) carried out in *Q. coccifera*.

Table 1: Macronutrient concentration values of acorn of *Q. canariensis* populations

	Na (mg/g DM)	K (mg/g DM)	P (mg/g DM)	Ca (mg/g DM)
El Ghorra	0,273c	7,349a	0,755b	0,004b
Bni Mtir	0,942a	5,638b	0,904ab	0,007a
Ain Snoussi	0,523b	6,910ab	0,825ab	0,003b
Nefza	0,347c	7,667a	0,963a	0,005b
Sig	***	***	**	*

Within a row, means with different letters differ at P < 0.05. Sig. = significant level. * P < 0.05. ** P < 0.01.*** P < 0.001. NS = not significant.

The micromineral composition of oak acorn flour is shown in Table 2. Significant difference was recorded for Mn and Fe, while no significant difference in Zn content. Nefza had the highest values of Fe and Zn 1,230 mg/g DM and 0.110 mg/g DM successively.

Bni Mtir population had the lowest Manganese (Mn) and Iron (Fe) contents 0,0317 and 0,491 mg/g DM respectively. Fe and Zn and Mn contents are higher than that recoded in *Q. robur* and some of the cereals (Sorghum, Barley, Wheat, Rise, and Oat) (Rakić *et al*., 2006).

Table 2: Micronutrient concentration values of acorn of *Q. canariensis*

	Mn (mg/g DM)	Fe (mg/g DM)	Zn (mg/g DM)
El Ghorra	0,053ab	0,720ab	0.0801a
Bni Mtir	0,0317ab	0,491b	0,080a
Ain Snoussi	0.145a	0,623ab	0,0757a
Nefza	0.070b	1,230a	0.110a
Sig	***	**	NS

Within a row, means with different letters differ at P < 0.05. Sig. = significant level. * P < 0.05. ** P < 0.01. *** P < 0.001. NS = not significant.

The heavy metal content is indicated in the table 3. No significant difference was found among populations. The acorn flours contained Cadmium (Cd) (average of 0.450 mg/g DM) and Copper (Co) (average of 0,08 mg/g DM), which maximum limit are acceptable and their quantities are in accordance with those recommended by the WHO/FAO. However, it did not contain Cobalt (Co) Chromium (Cr) and Nickel (Ni).

Table 3: Heavy metal concentration values of acorn of *Q. canariensis* populations

	Cd (mg/g DM)	Cu (mg/g DM)	Cr (mg/g DM)	Ni (mg/g DM)	CO (mg/g DM)
El Ghorra	0,044a	0,087a	0	0	0
Bni Mtir	0,049a	0,090a	0	0	0
Ain Snoussi	0,0387a	0,081a	0	0	0
Nefza	0,0463a	0,0727a	0	0	0
Sig	NS	NS	NS	NS	NS

Within a row, means with different letters differ at $P < 0.05$. Sig. = significant level. * $P < 0.05$. ** $P < 0.01$. *** $P < 0.001$. NS = not significant.

CONCLUSION

This investigation showed the richness of zeen oak acorns in minerals elements (K, P and Fe). Mineral contents are higher than that recoded in some of the cereals (sorghum, barley, wheat, rise, and oat). This content was depending on geographic origin of acorns in particular altitude and pedoclimatic conditions. Based on the results of our study, *Q. canariensis* acorns are a potent source of minerals elements. This reflects the high nutritional value of this natural product which can be used as minerals supplements in food industry and animals feeds.

ACKNOWLEDGMENTS

«This project is carried out under the MOBIDOC scheme, funded by the EU through the EMORI program and managed by the ANPR»

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