Mineral Content in *Capsicum* Pepper Landraces: Effect of the Genotype and the Ripening Stage

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Abstract. *Capsicum* peppers are one of the most important vegetables and a plethora of cultivars can be found within common pepper, *C. annuum*. In this regard, Spain is a center of diversity for this crop. Many studies on bioactive compounds have been done in peppers, although very little is known about their mineral content. In the present work fruits from a comprehensive collection of *Capsicum* accessions, mostly *C. annuum* landraces, were grown in open field in Valencia (Spain) and evaluated at both unripe and fully ripe stages for their content in several minerals: P, K, Ca, Mg and Fe. The effects of the genotype, fruit ripening stage, and the genotype×ripening stage were studied. A wide genotypic diversity was found for minerals. Thus, the difference between the lowest and highest genotype means was about twice in both ripening stages for P, Ca, and Mg and for K in fully ripe fruits. Finally, Fe levels were 0.7-3.1% in unripe fruits and 1.07-5.1% in fully ripe fruits. Our results indicate that *C. annuum* fruits are a good source of K, particularly when unripe. With very few exceptions, P, K and particularly Ca decreased on average and in most genotypes with the ripening process. By contrast, Mg showed a strong genotype×stage interaction. Here we found a wide diversity among *C. annuum* genotypes for the content in most minerals, particularly in P, Ca and Mg, as well as high levels of K. Moreover, unripe fruits usually show higher levels of these minerals than fully ripe fruits.

Keywords: *Capsicum peppers, fruit composition, mineral content, ripening stage, variability*

Introduction. Fruits from the cultivated forms of genus *Capsicum* are one of the most popular vegetables in the world and there is a plethora of dishes, pastes, and sauces in which peppers contribute with their particular color and flavor (DeWitt and Bosland, 2009). Their use, not only as vegetable, but also as a spice, as well as their introduction and adaptation to different regions and human preferences, has contributed to such diversity of uses (DeWitt and Bosland, 2009). Furthermore, *Capsicum* peppers can be utilized at both mature and immature stages. Among the species domesticated by humans, *C. annuum* L. or common pepper is the most popular, genetically diverse, and economically important species, and their cultivars are grown worldwide (Nuez *et al.*, 2003; DeWitt and Bosland, 2009). After the discovery of America, Spain was the entrance to Europe for many American species and, consequently, became an important center of diversity for this crop.

Moreover, in the last decades, consumers' preferences have evolved towards more healthy products, and many vegetables can provide high levels of minerals, vitamins, and/or antioxidants. At the nutritional level, *Capsicum annuum* fruits are known for their content in many bioactive compounds with antioxidant activity like ascorbic acid or phenolics (Rodríguez-Burruezo *et al.*, 2009). However, very little is known about their mineral content and the effect of genotype and ripening stage.

Aims and objectives. In the present contribution we studied the levels in P, K, Ca, Mg and Fe of different *Capsicum* peppers at the unripe and fully ripe stages. The objectives were:

Tab. 1. P, K, Ca, Mg and Fe level (mean, mg/100 g DM) in unripe and fully ripe *Capsicum* fruits.

Accession	P		K		Ca		Mg		Fe	
	Unripe	Ripe	Unripe	Ripe	Unripe	Ripe	Unripe	Ripe	Unripe	Ripe
C. annuum										
Ancho 101 B	287	269	2353	1832	34	13	155	112	0.98	1.65
Bierzo I.G.P.	304	207	2776	2045	31	16	201	200	1.70	5.12
Bola D.O.P.	306	166	2732	2755	34	10	189	145	1.51	1.98
Chile de Árbol	281	158	3929	2503	25	17	206	238	0.78	2.54
Chile Serrano	193	166	3270	2274	29	16	139	220	0.73	1.54
Guacilla Pulla	312	278	3392	2895	29	14	123	260	1.48	1.51
Jalapeño	251	158	2319	1802	34	16	153	102	1.13	1.07
Najerano	358	286	3332	1509	35	14	177	245	3.14	2.10
Numex Conquistador	250	200	2491	1917	29	16	182	204	1.30	1.32
Pasilla Bajío	347	247	2317	1767	32	15	239	166	2.00	1.47
Pimiento Valenciano	269	305	3298	2359	61	17	250	272	1.29	3.55
Piquillo	285	283	2402	2335	21	14	183	181	1.06	1.91
Ros Mallorquí	351	277	3091	2366	34	15	241	242	2.43	1.81
C. frutescens										
Ají Chirere	259	206	2773	1702	38	21	250	147	1.27	9.83
C. baccatum										
37R	190	162	2993	2258	30	19	210	274	1.04	2.05
MEAN	283	225	2898	2155	33	16	193	201	1.46	2.63

i) to study the effects of the genotype, ripening stage and their interaction (GxS) in the content of minerals and ii) to identify those cultivars with high content in one or more minerals at each ripening stage.

Materials and methods. Fifteen *Capsicum* accessions, mostly *C. annuum*, including several Spanish landraces, were grown in open field in Valencia (Spain) during the 2013 spring-summer season. Both unripe and fully ripe fruits were evaluated for their content in several minerals: P, K, Ca, Mg and Fe, according to MAPA methods (1994), based on five replicates (samples) per accession/fruit stage combination. Each sample was prepared with fruits from two different plants. Therefore, ten plants per accession and ripening stage were sampled.

Results and discussion. A wide genotypic diversity was found for minerals. Thus, genotypic differences were about two-fold between the lowest and the highest means in both stages for P (unripe: 190-351 mg/100 g; fully ripe: 158-305), Ca (25-61; 10-21), and Mg (123-250; 102-274) and for K in fully ripe fruits (1509-2755) (Table 1). Genotypic differences were still higher in Fe, with means comprised between 0.7 and 3.1% and 1.1-5.1% in unripe and fully ripe fruits, respectively (Table 1). On average and in most accessions, peppers showed higher levels in P, K, and Ca when unripe, although the contrary was true for Fe (Table 1). Finally, a remarkable GxS interaction was found for Mg, and some accessions showed higher levels at the unripe stage, while others showed the contrary. With very few exceptions, P, K and particularly Ca decreased on average and in most genotypes with the ripening process. By contrast, Mg and Fe showed a strong genotype×stage interaction.

Conclusion. Our results suggest that there are ample opportunities to select high-mineral content genotypes among *Capsicum* peppers, particularly when unripe, and also that *C. annuum* genotypes are a rich source of K (>2000 mg/100 g d.m.).

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