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PHYSICOCHEMICAL PROPERTIES OF FLOURS OF DESI AND APULIAN BLACK CHICKPEAS AS AFFECTED BY PROXIMATE COMPOSITION

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Introduction

Chickpea is the third most produced pulse in the world and Italy is the second producer of chickpeas in Europe after Spain (FAOSTAT data, 2017). Commonly, chickpeas are grouped in two commercial types: *desi*, characterized by a thick seed coat with brown or black pigmentation, and *kabuli* having beige-cream colored seeds. Furthermore, in Apulia region (Southern Italy) is traditionally cultivated a third and uncommon type of chickpea, named *Apulian black chickpea* ("Slow-food" quality mark-2013), bigger and darker than *desi* types and showing peculiar genetic traits (Pavan et al. 2017). Similarly to other traditional landraces, *Apulian black chickpeas* are being replaced by modern cultivars and are thus at risk of genetic erosion. Although the chemical composition and the physicochemical properties of the chickpeas flours are well investigated in literature, no information are available for the *Apulian black* chickpea flour. To overcome this gap, we studied the proximate composition and the physicochemical properties of a wide collection of *Apulian black* chickpeas (AC) flours in comparison with a wide collection of both *desi* (DC) and *kabuli* (KC) chickpeas, all grown in the same farm and under the same agronomic practices.

Materials and Methods


Desi chickpea

Plant materials

- 57 different chickpeas accessions (17 *desi* types, 21 *Apulian black* types, 19 *kabuli* types).
- Seeds were ground by an electric mill equipped with a sieve of 0.6 mm.

Proximate composition

- Proteins, lipids, ashes and total dietary fiber determined by AOAC Methods, 2006.
- Carbohydrates determined as differences.

Physicochemical properties

- Bulk density (**BD**), water absorption index (**WAI**), water solubility index (**WSI**), water (**WAC**) and oil (**OAC**) absorption capacities of flours were determined as reported by Du et al. (2014).

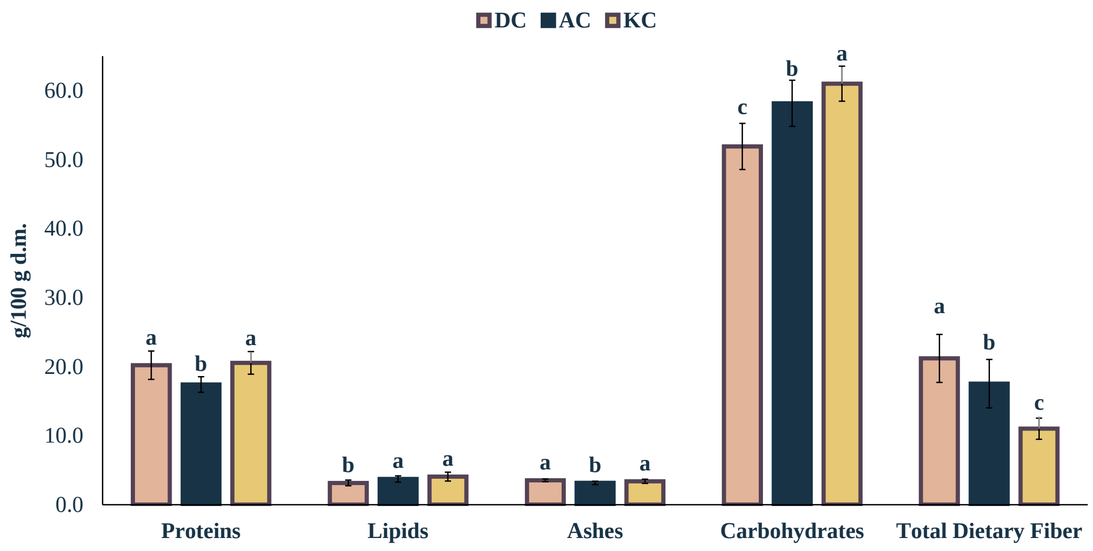

Apulian black chickpea

Pearson correlation matrix and One-Way ANOVA were carried out with XLStat software (Addinsoft SARL, NY, USA) at $\alpha = 0.05$.

Results and discussion

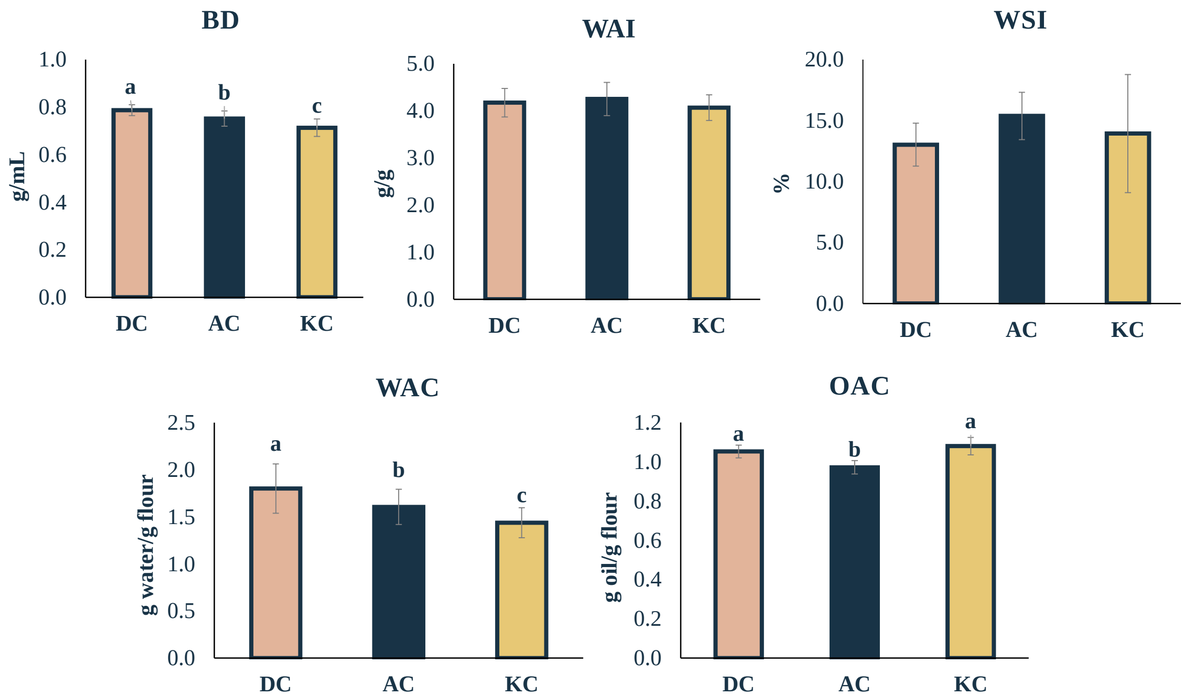
As shown in figure 1, AC were characterized by significantly lower content of protein and ashes content than DC and KC. The nutritional importance of chickpeas, besides the protein content, is related to the high content of dietary fiber, which is one of the highest among pulses (Jukanti et al. 2012). *Apulian black* chickpeas flours showed higher dietary fiber content than the commons *kabuli* types and significantly lower content than *desi* type.

Figure 1 – Mean values, standard deviation and results of statistical analysis of the proximate composition of *desi* (DC) *Apulian black* (AC) and *kabuli* (KC) chickpea flours.



Considering the physicochemical properties, significant differences among the genetic types of chickpeas were observed for BD, WAC and OAC (Figure 2).

Figure 2 – Mean values, standard deviation and results of statistical analysis of physicochemical properties of *desi* (DC) *Apulian black* (AC) and *kabuli* (KC) chickpea flours.



From a technological point of view, BD influences the formulation of weaning food. Thus, flours with lower BD, such as the KC and AC flour could be suitable for the preparation of infant foods due to their easy digestibility.

WAC represents the quantity of water that can be bound by a gram of flour. Therefore, flours with high WAC could positively affect the textural properties of foods made from a mix of cereals and legumes such as bakery products, helping to maintain a soft texture (Siddiq et al. 2010).

OAC represents the weight of oil retained by a gram of flour and it helps the texture preservation in food products that require oil incorporation, such as meat extenders. Furthermore it could help to maintain the flavor. Thus, DC and KC flours could be potentially more applicable in these food systems than AC ones.

Table 1 – Pearson correlation matrix considering the proximate composition and the physicochemical properties of chickpea flour.

	P	L	A	C	TDF	BD	WAI	WSI	WAC	OAC
P	**1**									
L	-0.061	**1**								
A	**0.481**	-0.116	**1**							
C	-0.204	**0.463**	**-0.400**	**1**						
TDF	-0.250	**-0.526**	0.131	**-0.889**	**1**					
BD	0.036	**-0.642**	0.188	**-0.571**	**0.590**	**1**				
WAI	**-0.366**	0.029	-0.170	0.005	0.156	-0.198	**1**			
WSI	-0.119	-0.209	-0.191	0.146	-0.051	0.209	**-0.422**	**1**		
WAC	-0.093	**-0.527**	0.221	**-0.567**	**0.625**	**0.658**	0.128	-0.021	**1**	
OAC	**0.551**	0.101	**0.262**	0.077	**-0.333**	**-0.350**	-0.094	-0.196	**-0.354**	**1**

P: protein; **L**: lipids; **A**: ashes; **C**: carbohydrates; **TDF**: total dietary fiber; **BD**: bulk density; **WAI**: water absorbtion capacity; **WSI**: water solubility index; **WAC**: water absorbtion capacity; **OAC**: oil absorbtion capacity.

The difference found for the physicochemical properties could be better explained by studying their correlation with the proximate composition (Table 1). BD was positively correlated with total dietary fiber contents, and negatively correlated with lipids. Furthermore, BD positively influenced the water absorption capacity (WAC) of flour.

Moreover, WAC was negatively correlated with lipid content, probably because of their hydrophobic behavior that hampers the water absorption mechanism. DC flour showed higher dietary fiber and lower lipid contents than AC and KC flours and this could explain the highest WAC.

OAC was positively influenced by the protein and ash contents, but negatively influenced by dietary fiber and bulk density.

Conclusion

The results of this study are a step forward in sustainable food technology. The evaluation of the physicochemical properties of *Apulian black* chickpea is useful to promote the use of its flour as ingredient in a wide array of food products.

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