The potential resource value of coffee residues

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Global production of coffee has increased because of higher consumption, leading to high generation of solid residues that are produced during the preparation process of a coffee beverage or through the manufacturing of coffee products. Statistics regarding coffee in Cyprus given by the ICO for year 2015, shows a total consumption of 86,000 (60kg bags) (ICO 2016). Per capita consumption is increasing the last 10 years, from 4.53Kg for 2012 (European Coffee Federation 2014) to 6.1kg for 2015 (ICO 2016), placing Cyprus among the highest consumption countries.

Chemical composition of coffee products and their solid wastes (Table 1), reveals products rich in fibres, proteins, oil and nutrient components. These components were proved to be valuable as they have been the source of several applications such as compost, animal feed, biosorbents, valuable source for phenolic compounds, used for bioenergy, and other food and health applications (Martinez-Saez et al. 2017). Possible methods of the exploitation and use of this waste have been investigated in recent years, emanating from the need of waste reduction and environmental protection.

Table 1. Chemical composition of traditional Cyprus coffee and its by products.

Parameter	**Unit**	**Untreated Green coffee seeds[1,3]**	**Traditional Cyprus coffee[1,3]**	**Silver skin[1,3,6]**	**Silver Skin[2,4,6]**	**Sediment from Cyprus coffee[3]**	**Spent Coffee Grounds[5,7]**
						g /100 g dry matter	
Moisture	%	8.91	1.78	2.63	--	--	--
Ashes	%	3.83	4.77	6.29	5.36	2.30	1.3-1.6
Fat	%	12.22	13.87	3.06	3.78	16.05	2.29
Proteins	%	13.59	15.01	14.75	18.69	14.75	6.7-17.44
Fibres	%	51.22	48.07	60.67	54.11	58.12	60.46
Ca	mg/100gr	118	132	1163	940	106	120
K	mg/100gr	1727	1889	2307	2100	661	1170
Mg	mg/100gr	187	209	333	310	99	190
P	mg/100gr	139.0	155.0	62.85	120	69	180
Cu	mg/100gr	1.8	1.5	4.53	6.33	2.0	1.86
Fe	mg/100gr	3.3	4.8	50.75	84.33	6.5	5.20
Mn	mg/100gr	2.2	2.6	7.125	5.00	1.8	2.88
Zn	mg/100gr	0.47	0.52	0.93	2.23	0.8	8.40
Caffeine	g/Kg	10.70	12.30	5.40		3.60	0.2

[1]Traditional Cyprus coffee (mixture of Arabica and Robusta coffee varieties)
[2]Mixtures of Arabica and Robusta coffee varieties

[3]: Present study; *[4]:* (Ballesteros et al. 2014); *[5]:* (Mussatto et al. 2011; Murthy and Naidu 2012; Ballesteros et al. 2014; Obruca et al. 2015; Martinez-Saez et al. 2017)
[6]: Silver skin is the thin outer layer of the green coffee bean obtained as a by-product during the roasting process
[7]: Spent coffee ground is the residual material obtained during the treatment of coffee powder with hot water or steam for the instant coffee production (which is the same as sediment)

The results obtained for the coffee by-products that is the sediment and the silver skin are comparable with the literature. The caffeine content in the Cyprus coffee sediment is higher probably due to the different treatment process.

Companies no longer consider residues as waste, but as a resource for other processes. Targeting the field of agriculture and food industry, solid residues attract the attention of many researchers as a promising substrate for various processes enabling the conversion of these wastes into value-added products, where they can fit into the waste hierarchy either as a product to be reused for feeding people or livestock, or for recovering valuable compounds so as to produce energy or other products such as fuels, materials, chemicals and energy (Cruz et al. 2012).

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