

Table 21. The occurrence of phenolic acids in *Amaranthus* species\*

Phenolic acids	Herb												Fruits					
	<i>A. caudatus</i> L.						<i>A. pani-</i> <i>culatus</i>			<i>A. retro-</i> <i>flexus</i>			<i>A. pani-</i> <i>culatus</i>			<i>A. retro-</i> <i>flexus</i>		
	<i>v. atropurp.</i>			<i>v. albiflorus</i>			A	B	C	A	B	C	A	B	C	A	B	C
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1. Ellagic	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	+	-	-
2. Gallic	+	+	-	+	-	+	-	-	+	+	+	+	-	+	-	-	+	-
3. Chlorogenic	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-
4. Protocatechuic	-	+	-	-	-	+	+	+	+	+	-	+	-	+	-	-	+	-
5. Homoprotocatechuic	-	-	+	-	+	+	-	+	-	-	+	-	-	-	+	-	-	-
6. Caffeic	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-
7. Gentisic	-	+	-	-	-	+	-	+	+	-	-	+	-	+	-	-	+	-
8. <i>p</i> -Hydroxybenzoic	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+
9. <i>p</i> -Hydroxyphenylacetic	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
10. <i>p</i> -Coumaric	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	+	-
11. Ferulic	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	+	-
12. Syringic	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	-	-
13. Vanillic	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+
14. Salicylic	-	+	-	+	+	-	-	+	+	+	+	-	-	+	-	-	+	-
15. 3,4 Dimethoxycinnamic	-	-	-	-	+	-	-	-	+	+	-	+	-	+	+	-	-	-
16. $\gamma$ -Resorcylic	-	-	-	-	-	-	+	-	+	+	-	-	-	+	-	-	-	-

A: free phenolic acids, B: phenolic acids released after acid hydrolysis, C: phenolic acids released after alkaline hydrolysis

\* Sokolowska-Woźniak (1996)

*al.*, 2002; Gupta and Prakash, 2009), they may have a hypercholesterolemic arteriosclerosis effect. Consumption of amaranth diet reduced LDL and total cholesterol levels and may be another option to prevent coronary heart diseases. The hypocholesterolemic effect of the seeds of *Amaranthus esculentus* (Chaturvedi *et al.*, 1993) and amaranth oil (Qureshi *et al.*, 1996; Berger *et al.*, 2003a; Martirosyan *et al.*, 2007) has been reported. On the other hand, Berger *et al.* (2003b) stated that amaranth flakes, including their protein, starch, oil, and phytochemical components did not show potent cholesterol lowering properties in hamsters. Combination of green amaranth with wheat and rice was found to lower glucose in humans with non-insulin dependent *diabetes mellitus* (Chaturvedi *et al.*, 1996-1997).

Lectin, extracted from the seeds of *Amaranthus leucocarpus* var. *algeria* hemagglutinated human, mouse, and chicken red blood cells (RBC). The lectin (specific for galactose-fucose) showed mitogenic activity of both bone marrow and total spleen cells. It inhibited the phagocytic activity of peritoneal macrophages to homologous erythrocytes. It also inhibited the primary immune response of mice to sheep RBC when the lectin was administered 2 days before immunization with RBC (Zenteno *et al.*, 1985).

*Amaranthus* spp. intoxication is rare in the animals; however, there are reports of cattle consuming leaf and portions of the plant and developing nephrotoxicosis and of swine developing peritoneal edema and nonspecific degenerative changes in the brain (Ramos *et al.*, 2005). Kimura *et al.* (1983) studied the mechanisms of adverse effect of amaranth feeding in rats. Their findings suggest that the toxicity of dietary amaranth is due to exfoliating of solubilizing effects of amaranth on the brush border membrane of the small intestine.