

Chemical Composition and Characteristics of a Zinc(II)-Chelating Fraction in Instant Coffee

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SUMMARY

A metal-chelating fraction was prepared from instant coffee, and its chemical composition and properties were investigated.

A hexamine buffer (10 mM, pH 5.0) with 20 mM ZnCl₂ was added to instant coffee to form an insoluble zinc(II) complex. This Zn(II) complex was dissolved in an aqueous ammonia (1%) solution, and precipitated by acidification with HCl. The resulting precipitate (sample Ap) was fractionated by chromatography in anion-exchange and cellulose columns. The zinc content determined by atomic absorption spectrometry was used as a purification marker for the Zn complex.

Fraction Ap V (0.3-0.4% yield) was found to have the strongest chelating activity, with a Zn(II)-dissociation constant of $-\log K_d = 8$, among the six fractions prepared by cellulose column chromatography.

Ap V was a brown amorphous compound, was soluble in water, and was antioxidative against linoleic acid. Its molecular weight was estimated to be 48,000 by HPLC. The contents of polyphenol by the Folin Denis method, of sugar, and of amino acid were found to be 30.4% as chlorogenic acid, 3%, and 4%, respectively. The chemical formula was experimentally found to be C₁₆H₂₁O₉N₃, and the nitrogen content of more than 10% is indicative of the involvement of the Maillard reaction.

Alkaline fusion of the Ap V fraction gave about 10% of low-molecular-weight polyphenols for the other-soluble fraction.

Various mixtures were prepared from chlorogenic acid, sugar and protein as coffee models, which were roasted and fractionated into Zn(II)-chelating fractions as instant coffee. These three compounds were essential for the formation of a brown polymer with Zn(II)-chelating activity. Increasing the proportion of chlorogenic acid in the mixture of these three compounds resulted in greater Zn(II)-chelating activity of aqueous substances in the roasted model.

Ap-V was found to be antioxidative against linoleic acid, and to show enzymatic activities of catalase and superoxide dismutase.