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Stereochemistry 2016: Synthesis, Characterization and Effectiveness of Chelated Mineral as Aflatoxin Absorbents - Ghada Mostafa El Ashry - Ministry of Agriculture

Ghada Mostafa El Ashry
Ministry of Agriculture, Egypt

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Introduction

Bioinorganic projects focus on the synthesis of transition complexes using ligand-peptide conjugates which will provide coordination environments similar to those found in biological systems. The design of new complexes plays an important role in bio-organic chemistry. A large number of metal-binding substances such as amino acids and proteins are present in biological systems. Low molecular weight substances are involved in the absorption and transport of metal ions and metalloproteins play various roles, such as enzymatic catalysis, oxygen transport and the storage and transport of metal ions. Proteins such as metallothionein protect organisms from the toxic effects of exogenous metal ions. Most amino acid complexes of transition metals have considerable biological activity, such as anti-tumor properties. Amino acids generally increase the diffusibility of complexes and improve their biological action inside the cell. Such systems are widely used in the field of chemotherapy. Structural studies of many transition metal complexes have shown that amino acids coordinate in various ways, depending on the metal ion, its oxidation state, and the primary structure of the amino acid. Methionine is one of the nine essential amino acids that humans need, and its copper (II) complex has shown some anti-ulcer activity as revealed by studies in animal models and has also found some interest in veterinary medicine, for copper supplementation.

Materials and Methods

Preparation of the complexes

Solutions of 0.08 mole of Mn, Cr, Co, Cu and Zn sulfate were mixed with 0.08 mole of methionine. The reaction mixture was heated at reflux for two hours, then left overnight where the complexes precipitated. Then filtered, washed with distilled water and dried in vacuum desiccators on P4O10. The melting points of the complexes are above 300 ° C.

Analysis of the metal content

The complexes were digested and decomposed with aqua regia. The metal ion contents were determined by atomic absorption spectra.

Carbon, hydrogen and nitrogen analysis

These studies were carried out at the Micro Analytical Laboratory, Faculty of Science, University of Tanta, Egypt.

Instruments and working procedures

IR spectra:

The KBr IR spectra were recorded using Perkin – Elmer spectrophotometer model 1430 covering the frequency range 200-4000 cm-1.

UV-Vis spectra:

The spectral studies were measured using PYEUnicam spectrophotometer model 1750 covering the wavelength range 190-900 nm. The complexes were measured in nujol mull following the method described by Lee et al.

Magnetic susceptibility measurements:

Molar magnetic susceptibility corrected for diamagnetic using Pascal? S constant were determined at room temperature applying the Faraday's method.

This work is partly presented at International Conference on Stereochemistry on August 18-19, 2016 at Sao Paulo, Ibirapuera, Brazil

Thermal analysis:

Des analyses thermiques différentielles (DTA) et thermo gravimétriques (TGA) ont été réalisées à l'aide de Shimadzu DTA-50. La vitesse de chauffage était de 20 ° C / min.

Effect complexes on aflatoxin concentration:

One liter of yeast extract broth was divided into 10 flasks. Each flask's content was mixed with one of the tested compounds to reach a final concentration of 2000 µg / ml.

Objective

To study the physical and chemical properties of the chelated mineral and its effect on aflatoxin.

Results and discussion

Infrared spectra of amino acid complexes

Methionine complexes:

The bands a 3342-3269, 3409-3349-3277, 3413.9-3237, 3317 cm-1 for the methionine complexes Mn, Cr, Co, Cu and Zn respectively, result from the coordination of the molecules H2O and the vibration of asymmetric stretch of NH2. The presence of a new band at 3269, 3277, 3237 and 3317 cm-1 in the methionine complexes Mn, Co, Cu and Zn respectively, is due to γs NH2. Thus, nitrogen from the amino group is involved in coordination [19]. It should be mentioned that free methionine exists in the form of zwitterions (NH3. AA. COO-) due to the presence of the characteristics γ (NH3) and σ NH3. The amino acid in complexes does not exist in zwitterions, NH3 is deprotonated and binds to metals by the neutral NH2 group. The transformation of NH3 into NH2 must lead to an upward displacement of γs NH2 and δNH2. During complexation, the two stretching vibrations δNH2 at 1695 and 1590 cm-1 as well as certain deformation movements of this group could be observed. The position of these bands clearly supports the involvement of this group in the collage. In addition, the stretching mode γ (C-N) at 1352 cm-1 is affected to different degrees in the complexation. IR spectra have shown strong evidence to support the involvement of the carboxylate group in coordination. The γas COO- and γs COO- at 1610 and 1410 cm-1 record displacements in the complexes. New ir bands appeared at 588-440 cm-1 are due to γ M-O and γ M-N. Thus, methionine acts as a bidentate ligand. The band at 2370 cm-1 allocated to γ (SH) not affected by complexation indicates that the atom (S) is not involved in the chelation.

Electronic spectra and magnetic moments of methionine complexes

For the chromium complex, three spin allowed transition have been observed at 249,286 and 428 nm assigned to charge transfer, but for 428nm is due to 4A2g (F)? 4T1g (F) respectively. The observed magnetic moment is 3.88 B.M due to the existence of octahedral geometry [23]. Mn methionine complex exhibit absorption bands at 245, 248, 251, 261, 263, 267 and 444 nm are due to d-d transitions. Its magnetic moments is 5.88 typified the existence of octahedral structure. The nujol mull spectra of cobalt methionine showed two bands at 249 and 434 nm, the band at 249 nm is due to charge transfer but the band at 434 nm is due to4T1g (F)? 4T1g (P) transition. Cu methionine complex exhibit absorption bands at 252,255,265,270 and 274 due to charge transfer type. The Ueff = 1.5 B.M is consistent with tetrahedral structure.

Thermal analysis of complexes

The DTA of Co methionine Co (L) 3 (HL) .4H2O, gave one endothermic peak at 205.3 ° C and two exothermic peaks at 305.7 ° C, 509.2 ° C, the order of reactions is 2.2, 0.95 and 1.56 respectively, i.e., the first and second types. The first broad DTA peak at 205.3 ° C (56.3-236.3) ° C is due to dehydration of lattice and coordination water molecules. The broad features of DTA peak may be due to strong thermal agitation accompanying the water elimination

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and loss of water molecules occurs in more than one step. This is confirmed by appearance of TGA peak at (53-233.2) ° C. The two strong exothermic peaks at 305.7 ° C and 509.2 ° C are due thermal agitation and decomposition steps of metal complex as evident from TGA. The latter peak at 509.2 and the associated TGA (415.2-560 ° C) and (560-700) ° C is assigned to the decomposition of the complex with weight loss 18.8 and 10.2% ended with the formation of CoO.

Conclusion

Transition metalamino acid complex (copper, zinc and cobalt methionine) have considerable biological activity against aflatoxin and the geometry structure of complex play an important role for adsorption of aflatoxin.

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