BRIEF ARTICLE

Chitin binds more cholate than chitosan

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Resumen: El grado de unión de la quitina obtenida de los exoesqueletos de muestras comerciales de *Penaeus* spp. con el colato de sodio es mayor que el mostrado por el quitosano, según mostraron experimentos de equilibrio (reacción de Pettenkofer). El proceso de adsorción obedece una isoterma de Langmuir del tipo I a 37°C y pH 7.0. Los valores encontrados para los parámetros de la ecuación K y q_{max} son 0.6 ± 0.2 mM y 0.18 ± 0.03 mmol/g para la quitina y 0.14 ± 0.05 mM y 0.032 ± 0.009 mmol/g para el quitosano. La quitina puede ser un buen agente para interrumpir la reabsorción enterohepática de las sales biliares en aves, permitiendo así obtener carnes con menor contenido de colesterol.

Key words: Chitin, chitosan, cholesterol, bile salts.

Chitosan (deacetylated chitin) is known to exert hypocholesterolemic activity and decreases hepatic cholesterol and triacylglycerol in experimental animals (Hirano *et al.* 1990, Knorr 1991, Ikeda *et al.* 1993, Le Houx & Grondin 1993). The ability of this insoluble polymer to sequester bile salts leads to a blockade of their enterohepatic recycling. This results in the decrease of circulating levels of blood cholesterol, because the fecal loss of bile constituents demands an increase in the hepatic transformation of cholesterol into bile acids.

Chitosan is obtained by reaction of chitin with 50% aq. NaOH at 140°C for 7 hr, and its cost is about three times higher than the cost of chitin.

This situation prompted us to determine whether less costly chitin would be a comparable chemisorbent agent for bile salts.

Chitin was prepared by disolving shrimp exoskeletons in cold concentrated HCl with further dilution, to give soluble mineral salts ($CaCl_2$, $MgCl_2$, etc.) and a precipitate of chitin in 30% yield (Díaz-Sánchez, 1994).

Adsorption isotherms were determined at 37°C and pH 7.0 for sodium cholate on both chitin and chitosan samples of similar granulometry. The data in Fig. 1 obey the type I Langmuir equation:

$$q = \frac{q_{max}\,(\text{Cholate})}{K + (\text{Cholate})}$$

where q is the amount of bile salt adsorbed on the solid material at equilibrium cholate concentration (Cholate), and q_{max} is the maximum binding capacity at saturation. The analytical measurements were carried out by determining free cholate by the Pettenkofer reaction (Sjovall 1964).

The values obtained at 37°C and pH 7.0 for the parameters are:

Chitin K = 0.6 ± 0.2 mM q_{max} = 0.18 ± 0.03 mmol/g

Chitosan K = 0.14 ± 0.05 mM q_{max} = 0.032 ± 0.009 mmol/g

This indicates a greater adsorption capacity for chitin than for chitosan. Although an ionexhange mechanism could be forseen as an important chemical force in the cholate/chitosan system, the hydrophobic interaction between cholate ions and chitin surface was revealed as a stronger mechanism.

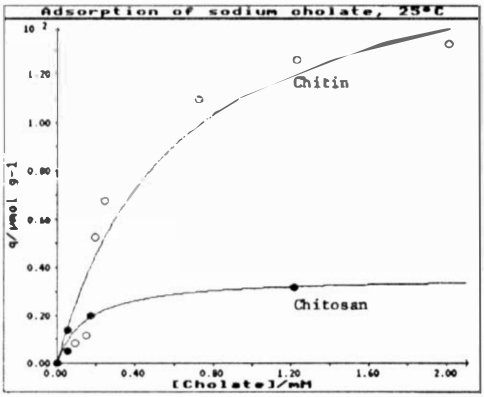

Fig. 1. Adsorption of sodium cholate on chitin and chitosan. pH = 7.0, 25°C.

Dietary intervention on poultry seems an interesting field to test low-cholesterol goals. In principle, the use of chitin -rather than the more expensive chitosan- as a supplement of the feed of chicks might find an important application in obtaining poultry products with a lower cholesterol content.

A four-week preliminary study (Chavarría Barrantes 1993) indicated that chicks fed with a test meal supplemented with 10% of shrimp cephalotorax, yielded breast meat with a 52 ± 6 % lower cholesterol content. More extensive studies must be carried out in this direction.

These results might also offer a dietary device to develop animal models, in which an increase in the fecal output of bile salts is pursued. A study of this nature is currently being developed in our laboratory.

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