EFFECT OF CHITOSAN AND ALGINATE ON THE BIOKINETICS OF RADIOSTRONTIUM IN RATS

Y.Nishimura,* I.S.Wui,* K.Y.Kim,K.Watari,** J. Inaba,*** K.Imai

Division of Environmental Health, National Institute of Radiological Sciences, 4-9-1, Anagawa, Chiba-shi 260, Japan,
* Department of Biology, college of Natural Sciences, Chonnam National University, Gwangju 505-787,Chonnam,Korea,
** Division of Comparative Toxicology,National Institute of Radiological Sciences,4-9-1, Anagawa,CHiba-shi 260,Japan,
*** Department of Veterinary Medicine, Faculty of Agriculture,Iwate University,3-18-8, Ueda, Morioka-shi 020,Japan.

ABSTRACT

The chelating effect of natural polymers on the radiostrontium was investigated on a single ingestion with chitosan and a long day pre-feeding diet with alginate in rats. After dosing of chitosan, Sr-85 was ingested orally to the rats and the whole-body retention of Sr-85 was investigated. The whole-body retention of the chitosan treated rats was lower than that of non-treated control.

INTRODUCTION

The radiostrontium, one of the nuclear division products flown out to the environmental area by the nuclear power plant accident and nuclear weapon accident. It brings out of a serious genetic disease like Bone Cancer, Hypocemia,etc. Therefore, it has been discussed out an important human health problem that the chelating of radiostrontium and the removing out of the body before or after accumulating to the bone. Chitosan derived from chitin which is a cellulose-like biopolymer distributed widlely in nature, especially in shell fish, insects, fungi and yeast, is known to be one of the natural chelating agents. The purpose of the present study is to investigate whether chitosan can be applied to the animal and human body and the long day pre-feeding effects of alginate in order to reduce the bioavailability of radiostrontium in foods. Many chelating agents-that is, DTPA,CDTA,EDTA,etc were reported as effective medicines. But they have some toxicity. So, we need a serious check to use of them at the real clinic experiment. Therefore, the discovery of non-toxic natural chelating polymer is quickly needed.

MATERIALS AND METHODS

Experimental animals used were male rats of the adult wister strain and 8 weeks of age, weighing about 250-300g, bred and supplied by the animal and plant supply section of National Institute of Radiological Sciences were used in this experiment. The rats were provided with a standard cubed diet(Fubashi Farm co. Fubashi, Chiba,Japan). Radiostrontium chloride ($^{85}SrCl_2$) with a specific activity of 430MBq/mg Sr was obtained from England Naclear, U.S.A through Radioisotope Association, Japan. This was diluted to 15KBq/ml of solution with normal saline solution and administered 0.5ml per one rat. Chitosan (Hwasung K.K, Tokyo, Japan) is slightly soluble in distilled water and alkali, it is soluble in some organic acids. 0.8, 2, 3% of chitosan solution was prepared by dissolution in IN actic acid. And also 0.8, 2, 3% of water soluble chitosan (Hwakwang K.K, Tokyo, Japan), the chemical form of 45-55% deacetylated chitin, solution was prepared by dissolution in distilled water. Chitosan solution was orally given and immediately after than 85Srcl2 was administered to rats using a stomach tube. The whole-body retention of Sr-85 was determined by in vivo counting. The percent of alginate food was given to rats during 10days and Sr-85 was administered orally.

CONCLUTIONS

The whole-body retention of Sr-85 determined by in vivo counting was lower than that of control rats which were not given chitosan.(Fig.1) And the effects were differented along the concentration variation of chitosan.(Table1) The activity ratio in urine and feces for chitosan- treated rats was higher than control rats.(Fig.2) The whole-body retention of Sr-85-alginate treated rats was decreased sharply compared with control rats.(Fig.3) These results suggested that chitosan and alginate can be used as a drug to reduce bioavailability from gastrointestine of ingested radiostrontium.

REFERENCES

1. ICRP Publication 30, 1967, Pergamon Press. Oxford, pp. 77-78. Keisuka K., Yoshiyuki K., Shin-ichiro N., and Mami K., 1989, Facile Preparation of Water-Soluble Chitin from Chitosan, Chemistry letters, pp. 1597-1598.
2. Kimie A., Toyosuke K., and Takao F., 1968, Toxicity of Chitosan, Bull. Tokai Reg. Fish. Res. Lab., 56, pp. 90-94.

3. Riccardo, A. A. Muzzarelli, 1971, Selective collection of trace metal ions by precipitation of chitosan, and new derivatives of chitosan, Anal. Chim. Acta, 54, pp. 133-142.
4. Satoshi F. and Haruzo I., 1987, Toxocological study of DTPA as a drug (III) side effect of orally administered Zn-DTPA to Beagles, Hoken Butsuri, 22, pp. 439-444.
5. Taylor, D. M., 1962, The absorption of calcium, strontium, barium and radium from the gastrointestinal tract of the rat, Biochem.J., 83, pp. 25-29.
6. Taylor, D. M., 1967, Strontium metabolism, Academic Press, London, pp. 175-180.

Table 1 Whole-body retention of Sr-85 in rats after oral administration

Days after dosing	Control	Chitosan (0.8%)	Chitosan (2%)	Chitosan (3%)	Continuous injestion (3% Chitosan)	Alginate (2%)	Alginate pre-feeding (10%)
1	15.3±4.4	15.0±6.4	13.0±1.9	8.8±2.6	12.7±4.8	19.3±4.8	7.9±2.4
2		10.7±6.2	8.1±1.7	6.7±1.7	7.7±3.9		3.5±0.4
3	11.5±1.2			6.2±1.6	6.7±3.8	13.4±4.9	3.2±0.5
4		9.7±5.9	6.7±1.4	6.0±1.4	6.7±3.7		3.1±0.5
5				5.7±1.4	6.3±3.7	12.7±4.7	2.9±0.5
6	11.0±1.1						
7		9.0±5.5	6.6±1.3	5.4±1.3	6.0±3.5	11.8±4.3	2.8±0.4
14	9.4±0.7	8.4±5.0	6.0±1.2	4.8±1.1	5.5±2.3	11.6±4.3	2.5±0.4

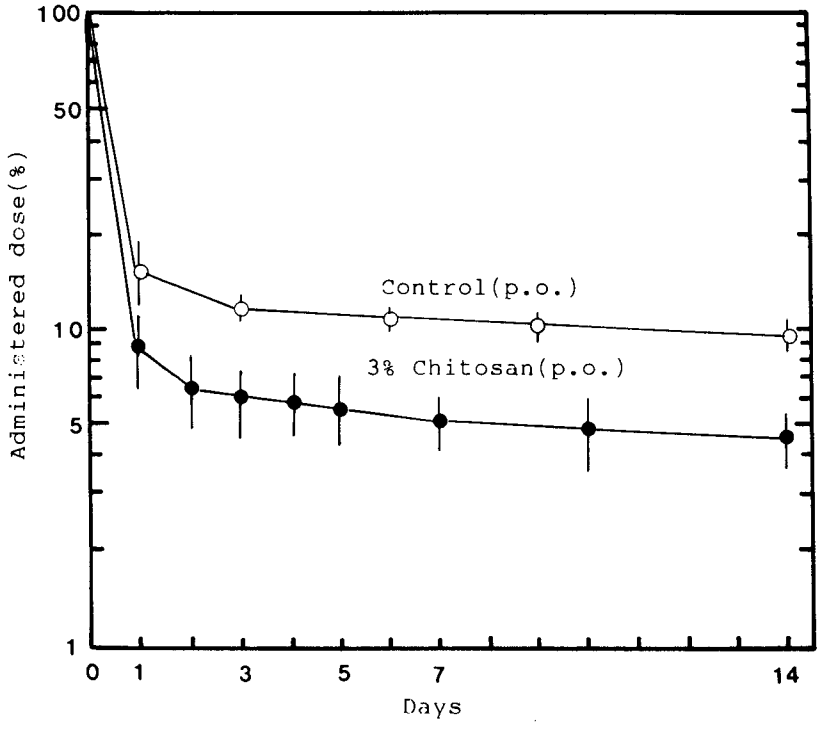

Fig.1 Whole-body retention of Sr-85 in rats after a single oral administration.

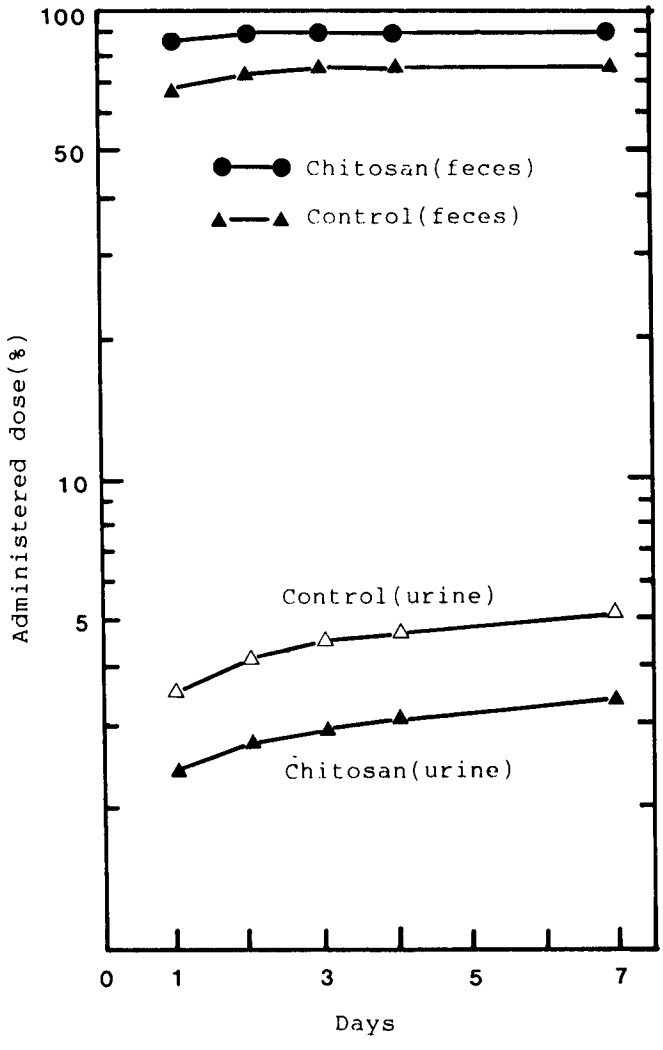

Fig.2 Cumulative excretion of Sr-85 in rats after a single oral administration.

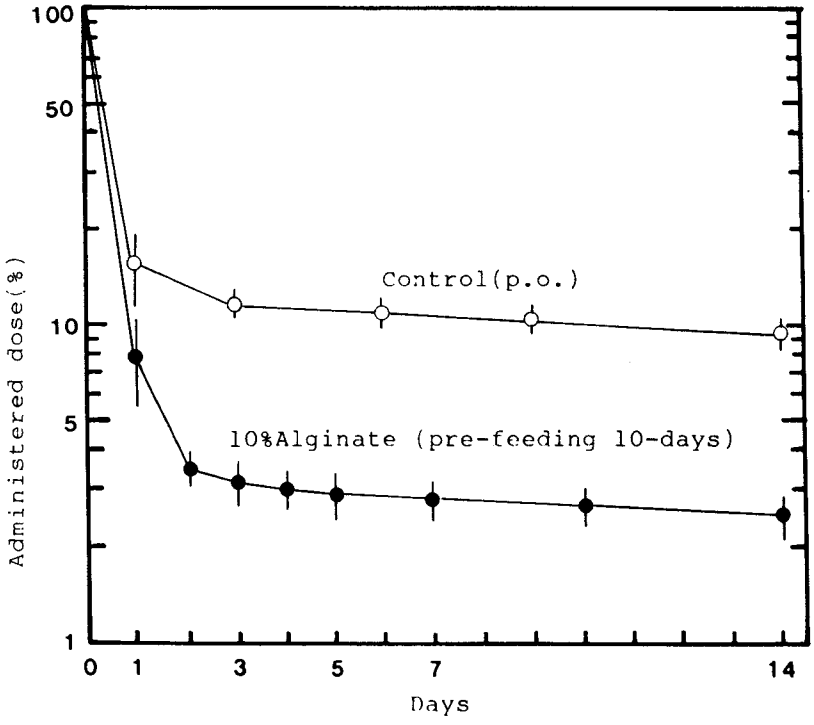

Fig.3 Whole-body retention of Sr-85 in rats after a single oral administration.