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Reducing the 137Cs-load in the organism of "Chernobyl" children with apple-pectin

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Summary

As a complement of standard radioprotective measures, apple-pectin preparations are given, especially in the Ukraine, to reduce the 137Cs uptake in the organism of children.

The question has been raised: is oral pectin also useful when children receive radiologically clean food, or does this polysaccharide only act in binding 137Cs in the gut, blocking its intestinal absorption? In this case, pectin would be useless if radiologically clean food could be given.

The study was a randomised, double blind placebo-controlled trial comparing the efficacy of a dry and milled apple-extract containing 15–16% pectin with a similar placebo-powder, in 64 children originating from the same group of contaminated villages of the Gomel oblast. The average 137Cs load was of about 30 Bq/kg bodyweight (BW). The trial was conducted during the simultaneous one-month stay in the sanatorium Silver Spring. In this clean radiological environment only radiologically "clean" food is given to the children.

The average reduction of the 137Cs levels in children receiving oral pectin powder was 62.6%, the reduction with "clean" food and placebo was 13.9%, the difference being statistically significant ($p < 0.01$).

The reduction of the 137Cs load is medically relevant, as no child in the placebo group reached values below 20 Bq/kg BW (which is considered by Bandazhevsky as potentially associated with specific pathological tissue damages), with an average value of 25.8 ± 0.8 Bq/kg.

The highest value in the apple-pectin group was 15.4 Bq/kg, the average value being 11.3 ± 0.6 Bq/kg BW.

Key words: "Chernobyl" children; reduction of the 137Cs load in the organism; controlled trial; oral Apple-Pectin vs. Placebo

Introduction

The radioactive fallout after the explosion of the Chernobyl power plant in the Ukraine, (April 26, 1986) exposed 23% of the territory of the neighbouring country, Belarus, to a 137Cs contamination of over 1 Curie per square km (>37 000 Bq/m^2). The agricultural production was stopped on 264 000 hectares. About 2 million people, among them 500 000 children, live in this area, contaminated principally with 137Cs and 90Sr [1].

The mobile teams of the Institute for radioprotection BELRAD measured the 137Cs load in the children's organism. So far 160 000 were checked: the 137Cs levels of 70 to 90% of the children of these regions exceeded 15–20 Bq/kg bodyweight (BW). In many villages the 137Cs levels reached 200–400 Bq/kg BW, the highest values being measured in the Narovlya district with 6700–7300 Bq/kg BW.

At the Medical State Institute of Gomel, under the direction of Prof. Yuri Bandazhevsky, studies were conducted during nine years, showing that the chronic accumulation of 137Cs in different organs contributed to progressive deterioration of health [2–3].

BELRAD created information centres for the rural population, equipped with spectrometers for measuring the 137Cs contamination of foodstuffs, milk and fodder, free of charge; 320 000 such samples were analysed. These teaching and informing efforts, as well as the radiologically "clean" food provided by the government twice a day to schoolchildren since kindergarten, also free of charge, did not lead to a satisfactory reduction of the 137Cs load in the organism of the children.

Therefore, we started to study pectin, a polysaccharide found in different sorts of fruits, and generally used in Europe for the preparation of sweets and jam. Purified pectin is also prescribed as an oral adsorbent for heavy metal (lead and mercury) intoxication. This medicament was initially developed by Sanofi (France) for the treatment of saturnism.

Since ten years, different pectin preparations based on milled dry-apple leftovers after pressing, are given orally to children living in radio-contaminated areas of the Ukraine, for reducing the radiocaesium load in their organisms. Korsum [4]

This trial was sponsered by "Enfants de Tchernobyl Belarus", F-68480 Biederthal.

showed that apple-pectin given to rats, together with radiocontaminated food, reduced significantly the uptake of 137Cs and strontium (Sr90).

In Belarus, the safety and efficacy of apple-pectin preparations, as well as their capacity to eliminate heavy metals from the organism was studied by Gres et al. [5].

Aim of the study

The objective of this study was to verify if pectin is still active in children when radiologically clean food is given, because the mode of action of this adsorbent is the binding of heavy metals (including 137Cs) in the intestinal lumen, the complex being then eliminated with the faeces.

Method

We planned to compare the percentages of the incorporated 137Cs eliminated from the organisms of two groups of children, all originating from the same rural area of the Gomel oblast, during their one-month stay in the Sanatorium "Silver Spring". In this radiologically "clean" environment all children received exclusively "clean" food.

Besides radiologically clean food, one group received one teaspoon of apple-pectin powder (5 g) diluted in water twice a day, at meals, for three weeks. The other group received the same food as well as a similar powder but containing no pectin, i.e. a placebo, for the same period of time.

All families were informed about the three weeks trial, which included a radiometric measurement before and after the trial. The children gave an oral informed consent, knowing that they could quit the trial any time, without any justification. All mothers gave a written informed consent, being told that all children from the placebo group would receive a box of pectin powder when leaving the sanatorium.

Sixty-four children accepted to participate in the study. Based on a randomisation table, 32 children received a box containing a 15–16% apple-pectin powder, and 32 a placebo powder. The key for the preparation given was kept by a member of the Ethical Committee, to be opened after all 137Cs measurements would be registered, and the complaints or clinical findings would be written down in the individual medical questionnaires.

The results compared the tolerance and acceptabil-

Table 1

Double-blind comparison of the 137Cs whole-body count (Bq/kg) of school-children, before and after a 3-week cure with simultaneous one-month stay in a sanatorium, with a radiologically clean environment and "clean" food. Comparison of the 137Cs whole-body count (Bq/kg bodyweight) in children before and after a 3 week pectine intake.

Name & Year of birth	Sex	137Cs whole-body count before pectine intake, Bq/kg	137Cs whole-body count after pectine intake, Bq/kg
A.A.N., 1993	F	40.2	15.3
B.I.S., 1992	F	36.0	12.6
B.Ju.E., 1990	F	34.9	13.9
G.A.N., 1993	F	34.5	15.4
G.E.V., 1993	M	34.0	14.1
G.E.V., 1990	F	33.9	15.3
G.N.O., 1992	M	32.5	11.7
G.V.V., 1991	F	32.5	12.7
G.M.N., 1992	F	31.8	12.2
G.V.N., 1990	F	31.3	13.9
Z.K.V., 1991	F	31.1	14.7
I.Ya.A., 1990	M	30.9	12.6
K.A.S., 1994	M	30.1	11.9
K.A.S., 1991	M	29.5	5.0
K.I.L., 1990	M	29.2	12.4
K.V.A., 1990	M	29.0	5.0
K.V.E., 1993	M	28.9	13.2
L.A.S., 1993	F	28.2	5.0
M.YA.N., 1992	F	28.1	5.0
M.R.S., 1992	M	27.9	11.6
P.E.M., 1993	M	27.8	11.9
S.E.F., 1993	F	26.2	12.3
T.A.V., 1993	F	25.8	10.2
T.V.S., 1991	M	25.8	11.0
F.D.A., 1992	M	25.6	9.2
Ch.D.V., 1993	M	25.4	10.0
Sh.R.A., 1990	M	25.3	11.9
Yu.A.L., 1993	F	25.3	5.0
Mean value		30.1 ± 0.7	11.3 ± 0.6

ity, as well as the difference in the percentage of reduction of the 137Cs load during the two courses, with a statistical analysis of each group.

Measurement of the whole body count of 137Cs

The radiometric measurements were performed by a team of BELRAD equipped with a mobile anthropogammametre "Screener-3M" of Ukrainian origin, with electronic registration of the findings. (The seven mobile spectrometres from BELRAD were cross-checked with two corresponding mobile spectrometres of the Research Centre Juelich "Canbera-Fastscan-whole BC", Germany. The difference did not exceed 11%. A second comparative control showed that differences in repeated examinations of a great number of children did not exceed 7%). The scientific accuracy of the measurements is also guaranteed by the annual, compulsory State Examination of the equipment.

Results

The key was opened by a member of the Ethical Committee, after the information was registered.

All 64 children completed the cure. The two preparations were equally well accepted and tolerated. Three families had to leave the sanatorium before the radiological control, so that four children missed this control. Two children (one of each group) refused to have a second 3-minute radiometric examination, without giving any reason.

Table 2
The mean decrease was 62.6% in the pectin-treated group. Comparison of the 137Cs whole-body count (Bq/kg bodyweight) in children before and after a 3 week placebo intake.

Name & Year of birth	Sex	137Cs whole-body count before placebo intake, Bq/kg	137Cs whole-body count after placebo intake, Bq/kg
A.R.V., 1992	M	48.4	41.8
A.D.E., 1990	M	37.0	31.2
A.N.O., 1990	F	36.2	31.3
B.V.G., 1992	M	35.2	27.5
V.A.V., 1994	M	34.7	29.0
G.D.A., 1993	M	34.4	30.5
G.A.S., 1993	M	33.9	28.0
G.V.V., 1993	M	33.5	29.2
G.V.S., 1993	M	32.5	27.5
Z.M.N., 1994	F	31.2	27.5
I.K.A., 1991	F	30.5	28.5
K.V.S., 1993	F	30.3	25.4
K.E.M., 1990	F	29.5	25.2
K.N.V., 1990	F	28.6	24.9
K.Ya.A., 1992	F	28.4	23.6
L.K.A., 1991	F	28.1	24.2
M.Yu.A., 1994	F	28.1	23.2
M.E.A., 1992	M	28.0	26.3
P.E.A., 1991	M	27.5	25.6
P.Ya.V., 1990	F	27.2	20.1
R.S.P., 1991	M	26.5	22.5
S.I.A., 1992	M	26.3	24.1
S.E.M., 1994	F	26.1	23.7
T.A.A., 1992	M	25.9	21.6
T.E.S., 1992	F	25.7	21.9
Kh.S.I., 1993	F	25.5	22.3
Kh.T.F., 1993	F	25.5	23.9
Sh.Ya.N., 1992	F	25.4	21.1
Yu.A.V., 1992	M	25.3	22.8
Z.I.S., 1993	M	24.8	20.0
Mean value		30.0 ± 0.9	25.8 ± 0.8

The mean decrease was 13.9% in the placebo-treated group. The difference in the decrease is statistically significant $p < 0.01$. The initial 137Cs values are identical in both groups. The average decrease of the 137Cs load was 62.6% in the Pectin-group. The average decrease of the 137Cs load was 13.9% in the placebo group. The difference was statistically significant, $p < 001$.

Therefore, the findings are based on 58 measurements. Table 1 shows the 137Cs load measured before and after the cures in each individual child, and the average levels in the two groups.

The initial average values for 137Cs were just above 30 Bq/kg bodyweight (BW) in both groups: 30.0 and 30.1 Bq of 137Cs/kg BW respectively.

After the cure, there was a drop of the 137Cs load in all tested children. However, no child from the placebo group reached values for 137Cs below 20 Bq/kg BW, the average value being 25.8 ± 0.8 Bq/kg BW, i.e. a reduction of 13.9% of the 137Cs load.

After the 3-week pectin intake, the highest value in a child of the group receiving apple-pectin was 15.4 Bq of 137Cs/kg BW. As values below 5.0 Bq/kg BW are no more within the limits of precise measurement, these findings were taken as being 5.0 Bq/kg BW. The average values in this group is 11.3 ± 0.6 Bq/kg BW, corresponding to a reduction of 62.6% of the 137Cs load.

The difference between the two groups is statistically significant ($p < 0.01$).

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