Bread Iodization for Iodine Deficient Regions of Russia and Other Newly Independent States

G. GERASIMOV, A. SHISHKINA, N. MAYOROVA, N. SVIRIDENKO, A. NAZAROV, G. ALEXANDROVA, G. KOTOVA, S. BUTROVA, M. ARBUZOVA, B. MISHCHENKO and I. DEDOV, Endocrinology Research Center, Russian Academy of Medical Sciences, Moscow, Russia

Bread is a major dietary item in Russia ("Father Bread" in folklore). By tradition, practically all meals are eaten with bread. The average bread consumption nationwide is 121 kg/per capita/year, about 350 grams per person each day. It is still one of the cheapest dietary items, 1 kg of brown or white bread costing US $0.30-0.50. Consumption has increased during the past 2-3 years due to economic changes in the country and to large increases in prices for meat, milk, fish, and poultry. Thus, bread has become a key dietary item for many families with low incomes, about 60% of the entire population.

The former USSR developed a unique system of centralized bread production. Most bread (80-90%) in certain areas is produced in relatively big, centrally-located mechanical bakeries (bread factories) and then delivered to consumers over a wide area. The factories either belong to local administrations or are private. Other conditions also suggest that bread would be a good vehicle for iodine supplementation. It is consumed within one to two days after purchase, so no iodine is lost during baking or storage. Potassium iodide is produced in Russia, can easily be obtained from existing stocks, and does not change the taste or odor of bread. Further, no changes in baking technology or capital investments are required for bread iodization. Costs are very low, about US $0.05 per capita/year, and can be met by the consumers.

Our objectives in the present project were to investigate the feasibility of bread iodization, to evaluate the amount of iodine required for effective fortification, and to study the effects of iodized bread in target groups.

Methodology

The study took place in Pavlov-Posad district of the Capital province, 60 km east of Moscow, an area of mild to moderate iodine deficiency. Its 110,900 inhabitants include 22,470 children below age 14 years. Most families are self-sufficient with vegetables, fruits, milk, poultry, and meat from their own production. Iodized salt was not available in this area. The local bread factory can produce 20 tons daily and covers the entire population of the district, including the villages. No other large and regular sources of bread were available.

Bread - No major changes were made in baking technology. Potassium iodide solution was added to a salt solution in a proportion of 60 mg KI/100 kg of flour, to reach a final level of 500-600 µg KI/kg of bread. This dose was chosen to provide consumers with a physiologic amount of iodine for a mean daily consumption of 350-500 g bread. The ingestion of more than 1 mg iodine/day by this route is highly unlikely. We carried out regular control of the iodine concentration in the bread in the biochemical laboratory of the Endocrinology Research Centre. To examine possible losses during baking, we measured iodine levels at 6, 24, and 48 hours after bread production. The mean concentration remained at 500-650 µg/kg without change.

Subjects - We followed two groups of children for nine months, as follows. *Group 1* contained 162 students, age 7-14 years, who spent six days a week in their boarding school in the town and received only iodized bread. The average daily bread consumption in this group amounted to 300 g, which contains about 150 µg of KI, near the recommended daily allowance. *Group 2* had 178 students, age 9-11 years, from the secondary school in a neighboring village 3 km away; they received iodized bread for five days a week, but only with the school breakfast; their average daily bread consumption was about 100 grams, or about 55 µg iodine from this source.

Children were studied according to WHO/-UNICEF/ICCIDD recommendations (1) at 0, 3, and 9 months after beginning iodized bread consumption. Thyroid size was measured by thyroid ultrasonography with a portable Philips SDR 1200 scanner (5.0 MHz transducer). The results were compared with normative data from populations with sufficient iodine (2). The volume of each lobe was calculated by multiplying thickness with length in cm and a correction factor (0.479) (3), and was considered enlarged when the volume exceeded the upper limit of normal for the given age. We measured iodine concentration in casual urine samples by the method of Wawschinek et al. (4).

Results and Discussion

The goiter prevalence in Group 1 was 11% (Table 1) and the urinary iodine concentration was 48 µg/l. Group 2 had more initial iodine deficiency, with a median urinary iodine level of 30 µg/l and a 24% goiter prevalence. These results agree with our earlier data showing a difference in iodine nutrition in rural and urban populations in Russia (5). The more severe degrees of IDD in the rural population may be attributed to greater dependency on local food supply (meat, milk, poultry, vegetables and fruits).

After three months of iodized bread consumption, the median urinary iodine level increased in both groups, reaching 126 µg/L in Group 1 and 60 µg/L in Group 2. The thyroid volumes did not change at that time. On final assessment at nine months, the median urinary iodine levels remained about the same as at three months (138 µg/L in Group 1 and 62 in Group 2). Before introduction of iodized bread, 13% of the urine samples had less than 20 µg/L iodine and only 7% were greater than 100 µg/L. Nine months later, 66% of samples were greater than 100 µg/L and none contained less than 20 µg/L. In Group 2, the fraction of samples with iodine concentrations below 20 µg/L decreased from 42% to 10% and those greater than 100 µg/dL increased from 4% to 18%.

The goiter prevalence decreased in both groups after nine months of iodized bread consumption, going from 11% to 5% in Group 1 and from 24% to 14% in Group 2. The thyroid volume in Group 1 decreased in most age groups. Median volumes