

Short communication

Effect of thiocyanate ingestion through milk on thyroid hormone homeostasis in women

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A thyroid-hormonal evaluation of thirty-five women consuming commercially packed milk containing thiocyanate was carried out. The mean serum thiocyanate concentration, which was measured by the FeCl₃ colour test, was significantly higher ($P < 0.01$) than that of control subjects. Serum thyroxine (T₄), triiodothyronine (T₃) and thyroid-stimulating hormone (TSH) concentrations of exposed women were compared with those of thirty-five control subjects. Thiocyanate ingestion was associated with lower levels of T₄ ($P < 0.01$) and higher levels of TSH ($P < 0.01$) compared with the control subjects. T₃ was found to be higher in the women consuming thiocyanate-containing milk but the difference was not significant. The serum T₄ level was found to be negatively correlated ($r = -0.359$, $P < 0.05$) while the TSH level was positively correlated ($r = 0.354$, $P < 0.05$) with thiocyanate concentration in the exposed group. From this study, it appears that ingestion of milk with added thiocyanate impairs thyroid function.

Milk: Thiocyanate: Thyroid

It has been found that the lactoperoxidase–thiocyanate–hydrogen peroxide system (LP system) can be successfully used for retarding bacterial growth in raw milk (Kalra, 1981; Singh & Ranganathan, 1981). In this system, H₂O₂ produces OSCN which acts as a bacteriostat (Babu & Shemoli Kar, 1992). The process of preservation by the LP system requires addition of thiocyanate to the milk. The prevalence of thiocyanate use for milk preservation in the range of 30–50 mg/l is practised in local dairies, despite its limited international use.

Thiocyanate, with the same molecular size as iodide, competitively inhibits I and tyrosine oxidation when present at high concentrations (60–80 μmol/l) and thus affects I metabolism by inhibiting the uptake of I by the thyroid gland, whereas at low concentration (0.5–1.0 μmol/l), it exerts a stimulatory effect on the coupling reaction by interacting with thyroid peroxidase (iodide peroxidase; EC 1.11.1.8) (Geen, 1978).

In view of these facts, we were interested in assessing thyroid function in women who regularly consume commercially packed cows' milk containing thiocyanate, by analysing and correlating the indicators of thyroid function to the serum thiocyanate level. Serum thyroxine (T₄), triiodothyronine (T₃) and thyroid-stimulating hormone (TSH) concentrations were used as the biochemical indices of thyroid function.

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METHODS

Thirty-five women who, for more than five consecutive years, had consumed 250 ml/d of a commercially packed cows' milk available in Calcutta city, were designated as the thiocyanate-exposed group. Thirty-five non-exposed women, matched for age and dietary habits, who had consumed the same quantity of raw cows' milk, were designated as the control group. All subjects were selected randomly from a population of similar socioeconomic status with a uniform dietary pattern who did not use tobacco products and had no prior history of thyroid disease.

Blood (5 ml) was collected from each subject. The sera were separated by centrifugation at 3000 rev./min for 10 min and stored at -20° .

T_3 and T_4 estimations were performed by enzyme immunoassay, using the kit manufactured by UBI-Magiwel, (Mountain View, CA, USA; catalogue nos. HP-702 and HP-703), whereas TSH estimation was by radioimmunoassay using a kit from the Bhaba Atomic Research Centre (Bombay, India) (Bhandarka & Pillai, 1992). Thiocyanate was analysed by the $FeCl_3$ colorimetric test (George & Schenck, 1983). The cerous-arsenite reaction was adapted to the measurement of urinary I levels (Benotti *et al.* 1965). All the samples were assayed in the same run.

The normal ranges for T_3 , T_4 and TSH provided by the manufacturers of the kits were 0.93–3.12 nmol/l, 110–270 nmol/l and 0.2–4.0 μ U/ml respectively. While the normal level of serum thiocyanate is typically stated as 34–69 μ mol/l (Pechacek *et al.* 1985), the level ranged from 80 to 100 μ mol/l in non-smokers in another study (Banerjee & Marimuthu, 1994).

Pearson's correlation coefficients and Student's *t* test were used for data analysis.

RESULTS

Measured urinary I level was found to be 115 (SE 8.5) μ g/l in the exposed group which was almost identical to that of the control group (123 (SE 7.8) μ g/l) and there was no statistically significant difference in urinary I concentration between these groups.

Significantly lower levels of serum T_4 ($P < 0.01$) and higher levels of TSH ($P < 0.01$) were observed in the thiocyanate-exposed group compared with the non-exposed control subjects. Serum T_3 level was found to be higher but the increase was statistically insignificant (Table 1).

In the exposed group a significant negative correlation was found between serum T_4 and thiocyanate concentrations ($r = -0.359$, $P < 0.05$) and a significant positive correlation was

Table 1. Comparison of serum thyroxine (T_4), triiodothyronine (T_3), thyroid-stimulating hormone (TSH) and thiocyanate (SCN) levels of thiocyanate-exposed women with those of non-exposed controls (all non-smokers)

(Mean values with their standard errors for thirty-five subjects)

Study group . . .	Thiocyanate-exposed women		Non-exposed controls	
	Mean	SE	Mean	SE
SCN (μ mol/l)	230.0**	10.0	90.8	9.0
T_4 (nmol/l)	87.8**	6.6	125.4	11.5
T_3 (nmol/l)	2.39	0.32	1.71	0.16
TSH (μ U/ml)	2.49**	0.20	1.09	0.28

** Mean values were significantly different from those for the control group, $P < 0.01$.

found between serum TSH and thiocyanate concentrations (r 0.354, $P < 0.05$). No significant correlations of T_3 , T_4 and TSH with thiocyanate concentrations were found in the control group. The observed values for all the indices were normally distributed.

DISCUSSION

The significantly higher serum thiocyanate concentration in the women consuming thiocyanate-containing milk is consistent with their presumed greater exposure than that of the control group. The average thiocyanate concentration in the milk was found to be 45 mg/l.

A number of carefully studied cases of goitre subsequent to thiocyanate therapy for hypertension have been reported, and in all of these cases the goitre decreased in size when the thiocyanate administration was terminated or following treatment with thyroid hormone. Substances such as cabbage, cyanide and thiocyanate salts have all been used successfully to produce goitres in animals, and experimental study of such goitres has shown that the thiocyanate radical is responsible for this effect through prevention of I uptake (Vogel *et al.* 1981).

Our findings of decreased levels of T_4 and increased levels of TSH in the women consuming thiocyanate through milk indicated that thiocyanate does inhibit I metabolism by the thyroid gland. The level of T_3 , the metabolically more potent of the thyroid hormones, was found to be elevated but this was not statistically significant. One could well speculate that this reflects a compensatory increase in the efficacy of thyroid hormone synthesis.

Normally T_3 and T_4 influence TSH secretion through negative feedback regulation. Both T_3 and T_4 might have had an influence at the pituitary level and the slight excess of circulating T_3 as found in the present study could have shut down the release of TSH, whereas the lower level of T_4 might have caused an enhanced secretion of TSH. The higher level of TSH in the exposed group within the normal range could be the net result of two opposing effects, of which the effect of the lower level of T_4 was predominant.

Therefore, our findings suggest that ingestion of thiocyanate-containing milk inhibits T_4 synthesis. However, due to normal regulatory mechanisms circulating levels of T_3 and TSH are enhanced.

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