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Effect of Common Vegetables on Thyroid Function in Rats—A Preliminary Study

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Abstract. Goitrogenic potency of some vegetables of Delhi were studied in rats. Adult male rats were fed separately on thiouracil, thiocyanate and extracts of carrot, cabbage and turnip procured from Delhi market for 26 days. Cabbage and turnip showed high thiocyanate contents while carrot did not show any measurable amount. Appreciable increase in thyroid weight to body weight ratio, plasma thiocyanate, plasma ^{131}I contents and protein bound ^{131}I or plasma were observed in all groups of experimental, rats, except carrot. Results indicated goitrogenic nature of cabbage and turnip in rats.

1. Introduction

Until recently it was generally believed that endemic goitre results from a deficiency of iodine in external environment. Although iodine deficiency is well established as an etiological factor, but it is not the sole cause is evident from the fact that goitre also occurs in areas, where there is a high concentration of iodine in soil and water. In other words, prevention of endemic goitre does not begin and end with iodine intake but other factors must be taken into account. Dietary iodine deficiency does not always result in endemic goitre nor does iodine supplementation completely eradicate and prevent goitre development in certain areas of the world.

There is convincing evidence that other environmental factors act in conjunction with iodine deficiency in the development of goitre[1]. One such environmental factor is the goitrogen in food. The classical study in this regard is goitrogen in cabbage[2] which was discovered more than five decades ago. Since then various goitrogens have been identified in several food materials[3-11] in different countries of the world.

In recent years, significant increase in the incidence of goitre[12-14] has been reported from various non-endemic regions of India, which include coastal areas and interior regions namely Punjab, Haryana, Madhya Pradesh and Delhi. This has

necessitated rethinking regarding the etiology of goitre in those areas. It is presumed that study of goitrogens in various foodstuffs might possibly be of great significance in explaining the high incidence of goitre in those areas, in the context of findings in other countries of the world. This communication reports the study of goitrogenic potency of some common vegetables and their effect of thyroid function in experimental rats.

2. Materials and Methods

Adult male Sprague Dawley rats were used in this study. Experimental rats were separately fed thiouracil (1 mg daily each rat), thiocyanate (2 mg daily each rat) and extracts of carrot, cabbage and turnip (approx 9 gm daily each rat) for 26 days. Thiocyanate contents of the vegetables were estimated calorimetrically[15]. 24 hours before sacrificing the animals, each rat was injected 8 μCi. ^{131}I. After scheduled time, rats were anaesthesised with ether, blood was collected in heparin and plasma separated. Plasma thiocyanate was measured calorimetrically[16]. Thyroid weights were taken in a torsion balance. Radioactivities in plasma and thyroid were measured in ECIL well type gamma counter. Protein bound ^{131}I was precipitated with 10% trichroacetic acid and counts taken in the precipitate. Results are shown in Tables 1—4.

3. Results and Discussion

Various vegetables were procured from Delhi market and their thiocyanate contents were estimated. Among these cabbage (1.8 mg/100 gm), turnip (2.2 mg/100 gm) and ladies finger (4.0 mg/100 gm) showed high values. Carrots did not show any measurable thiocyanate content. The present study was conducted on rats fed on cabbage

Table 1. Effect of vegetables feeding on thyroid/body weight ratio in experimental rats.

(values are mean $\pm$ SE of 6 rats in each group)

Groups	$\frac{\text{Thyroid weight}}{\text{Body weight}} \times 10^{-5}$
Control (Carrot)	4.52 ± 0.33
Experimental	
Cabbage	6.32 ± 0.6*
Turnip	8.6 ± 0.6**
Thiouracil	9.6 ± 0.3**
Thiocyanate	10.0 ± 0.001**

* $P < 0.05$; ** $P < 0.001$

Table 2. Effect of vegetables feeding on plasma thiocyanate in experimental rats.

(values are mean ± SE of 6 rats in each group)

Groups	μg/300 ml Plasma
Control (Carrot)	43.4 ± 1.1
Experimental	
Cabbage	85.6 ± 8.4*
Turnip	94.2 ± 6.2*
Thiouracil	103.9 ± 17.5*
Thiocyanate	110.1 ± 16.0*

*$P > 0.001$

Table 3. Effect of vegetables feeding on total and protein bound I^{-131} in experimental rats.

(values are mean ± SE of 6 rats in each group)

Groups	Total ^{131}I cpm/ml Plasma	Protein Bound ^{131}I cpm/ml Plasma
Control		
(Carrot)	2231 ± 157	1561 ± 156
Experimental		
Cabbage	3458 ± 144*	2763 ± 100*
Turnip	2892 ± 82*	2469 ± 119*
Thiouracil	8726 ± 312*	7306 ± 246*
Thiocyanate	3678 ± 332*	3198 ± 204*

*$P < 0.001$

Table 4 Effect of vegetables feeding on thyroidal uptake of ^{131}I in experimental rats.

(values are mean ± SE of 6 rats in each group)

Groups	% Uptake/10 mg Thyroid
Control (Carrot)	5.14 ± 0.23
Experimental	
Cabbage	4.22 ± 0.15*
Turnip	4.67 ± 0.27
Thiouracil	2.55 ± 0.24**
Thiocyanate	4.96 ± 0.34

*$P < 0.01$; **$P < 0.001$

and turnip using carrot fed rats as control. Similar values of thiocyanate in cabbage and turnip have also been reported on studies in other countries[3,5,6,17&18].

Thiouracil exhibits antithyroid activity by inhibiting organic binding of iodine[19] and thiocyanate inhibits trapping of iodine[20]. Hence thiouracil and thiocyanate were also used alongwith cabbage and turnip to have a comparative idea about goitrogenic potency. Results of Table 1 show highly significant increase in thyroid weight to body weight ratio in cabbage and turnip fed rats and also in those fed on thiouracil and thiocyanate. Similar increase[21] in thyroid weights with cabbage feeding has also been reported.

Appreciable enhancement of plasma thiocyanate occured in all four groups of experimental rats (Table 2) indicating goitrogenic nature of the vegetables. Increase in plasma thiocyanate has also been reported[22] in rats fed with cabbage. Results of Table 3 reveal significant increase in total and protein bound ^{131}I in plasma of both cabbage and turnip fed rats and also thiouracil and thiocyanate groups. Above results are in agreement with the findings in guinea pigs[23].

Calculated per 10 mg of thyroid weight, rats on turnip and thiocyanate exhibited diminution of thyroidal uptake of ^{131}I but the results are not statistically significant. On the other hand, cabbage and thiouracil fed rats showed significant diminution of thyroidal uptake of ^{131}I, similar to the findings reported[24] earlier.

Goitrogenic activity of various foodstuffs is now firmly established and has been confirmed by studies on thyroid physiology and biochemistry in experimental animals[25–32]. Antithyroid activity of several foods in man has also been confirmed[33]. The study of environmental goitrogens, specially in foodstuffs is complex, multifactorial, dependent on seasonal, and regional variations and has not yet been fully delineated[34].

The results of this preliminary study reveal goitrogenic nature of the common vegetables namely cabbage and turnip in experimental rats. This study does not reveal an answer to the problem of high incidence of goitre in several non-endemic areas in India as reported recently but provides a new approach to the problem which has since not been explored in our country and requires the team work of research workers from various disciplines. New knowledge gained in the present study when applied to other foodstuffs as well could be beneficial in understanding the etiology of endemic goitre as prevalent in different regious of India.

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