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EFFECT OF GLUCOSINOLATE AUTOLYSIS PRODUCTS ON RAT SERUM T_3 AND T_4 CONCENTRATIONS

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ABSTRACT

The glucosinolate autolysis products of crushed seeds of *Descurainia sophia L.* (khakeshi) and *Brassica napus L.* (shelghem) were administered orally to rats in doses representing 8, 16 and 32 gm seeds/kg body weight/day at intervals of 10, 20 and sometimes 30 days. Serum T_3 and T_4 concentrations were reduced in 10 day-autolysate treated animals in a similar fashion to that found with methimazole. The antithyroid effect persisted until day 20, but was weaker than that seen with methimazole. By day 30, serum T_3 and T_4 concentrations returned to normal in plant treated animals.

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INTRODUCTION

The glucosinolates are common chemical constituents of some plant families, notably the Cruciferae. On crushing different parts of these plants, autolysis is brought about by contact of glucosinolates and the endogenous myrosinase enzyme system, yielding one or more of the following products: isothiocyanate, nitrile, thicoyanate, cyanoepithioalkane, thionocarbamate or oxazolidinethione, along with glucose.[1,2]

In a previous work, the major glucosinolate and its autolysis products were determined in *D. Sophia* and *B. napus* seeds.[3,4] Using a direct extraction method, the major glucosinolate in seeds of both plants was found to be 3-butenylglucosinolate (1), which on autolysis produced mainly l-cyano-3,4-epithiobutane (2) in *D. sophia* but 3-butenylisothiocyanate (3) in *B. napus* (Figure 1). However, traces of other glucosinolate autolysis products were detected in seeds of both species, but their levels were very low.[3,4]

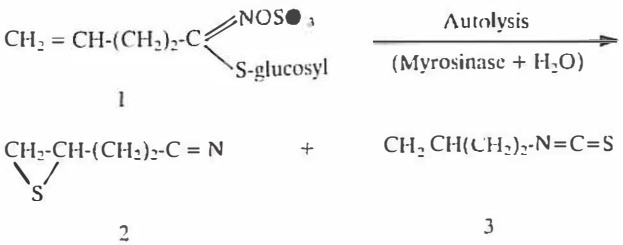

Figure 1. Autolysis of 3-butenylglucosinolate (1) and production of l-cyano-3, 4-epithiobutane (2) and 3-butenylisothiocyanate (3).

Since little has been done in regards with the proposed antithyroid effect of glucosinolate autolysis products (i.e., isothiocyanates, nitriles, ... etc.),[1] it has become the aim of this study to examine the effects of these substances on rat serum T_3 and T_4 concentrations. The effect of extracted autolysis products on thyroid function parameters was compared to that of methimazole as a well documented antithyroid agent.

MATERIAL AND METHODS

Plant Material: Seeds of *Descurainia sophia L.* and *Brassica napus L.* were cultivated, and the fully developed plants were characterised by the Botany Department of Manchester Museum.

Autolysis and Collection of Glucosinolate Autolysis Products: Crushed seeds (600 gm) were mixed with distilled water (1000 ml) and left for autolysis at 25° overnight (17 hr). Diethyl ether was then added and the mixture was shaken for 2 hr.[3,5] The etherial layer was then separated and evaporated under reduced pressure leaving an oily residue which constituted the autolysis product of major glucosinolates.[3]

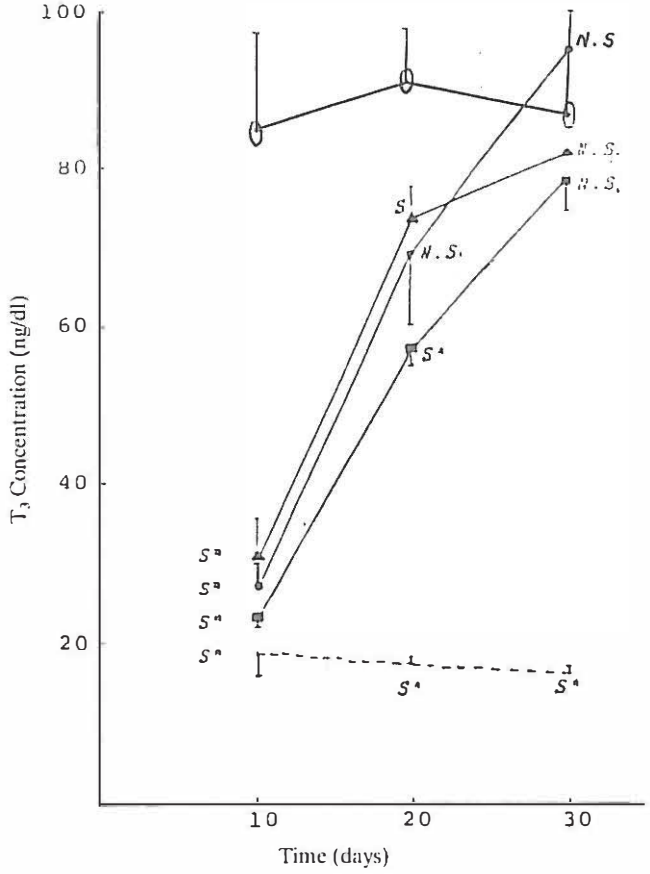

Figure 2. The effect of three different doses of *D. sophia* autolysate on serum T_3 concentration after 10, 20, and 30 days oral administration.

Serum T_3 concentration of control animals (○ – – ●), and animals fed with 20 mg/kg body weight/day methimazole (----), or *D. sophia* autolysate representative of 8 gm seeds/kg b.wt./d. (▲ – – ▲), 16 gm seeds/kg b. wt./d. (● – – ●) and 32 gm seeds/kg b.wt./d (■ – – ■).

S = P<0.05, S* = P<0.001, N.S. = not significant

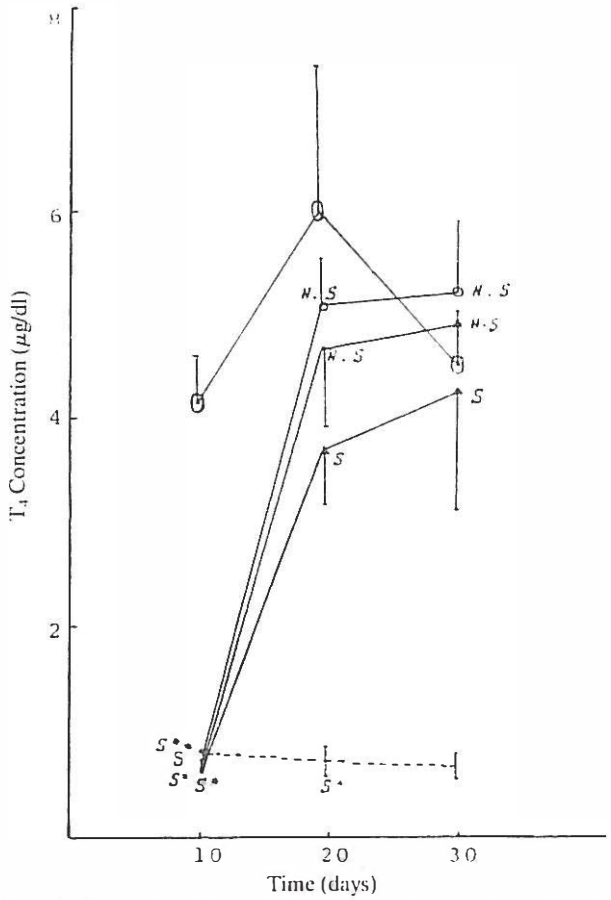

Figure 3. The effect of three different doses of *D. sophia* autolysate on serum T_4 concentration after 10, 20, and 30 days oral administration.

Serum T_4 concentration of control animals (○ – – ○) and animals fed with 20 mg/kg b.wt.d. methimazole (----), D. sophia autolysate representative of 8 gm seeds/kg b.wt./d. (▲ – – ▲), 16 gm seeds/kg b.wt./d. (● – – ●) and 32 gm seeds/kg b.wt./d. (■ – – ■).

S = P<0.05, S* = P <0.001, N.S. = not significant

Oral Administration of Glucosinolate Autolysis Products and Methimazole to Rats: The autolysate of each plant's seeds was administered orally to several groups of rats (five rats in each group, 200-300 gm) using special syringes. The selected oily doses were representatives of 8, 16, and 32 gm seeds/kg body weight/day. The groups were fed for 10, 20, and sometimes for 30 days. Meanwhile, to separate groups of rats, 20 mg/kg body weight/day methimazole was orally administered.[6] Three groups of five animals were given distilled water for 10, 20, and 30 days, respectively, and were considered control animals.

Determination of Serum T_3 and T_4 Concentrations: Groups of rats fed for different specified intervals of time with the glucosinolate autolysis product and methimazole were decapitated, and blood samples were collected for analysis. Serum T_3 and T_4 concentrations were determined using radioimmunoassay (RIA) method. Kits of T_3 and T_4 were obtained from Diagnostic Products Corporation (DPC , Los Angeles, CA 90045, USA), and the gamma counter used was a computerized LKB model (Wallac) connected to a recorder.

RESULTS AND DISCUSSION

Figure 2 shows the effect of three different doses of *D. sophia* autolysate on serum T_3 concentration after 10, 20, and 30 days compared with serum T_3 concentration of groups fed with methimazole, and groups fed with distilled water for the same intervals of time. Methimazole reduced serum T_3 concentration to about one-fifth of its original concentration in 10 days, and this reduction continued during the next 20 days but not

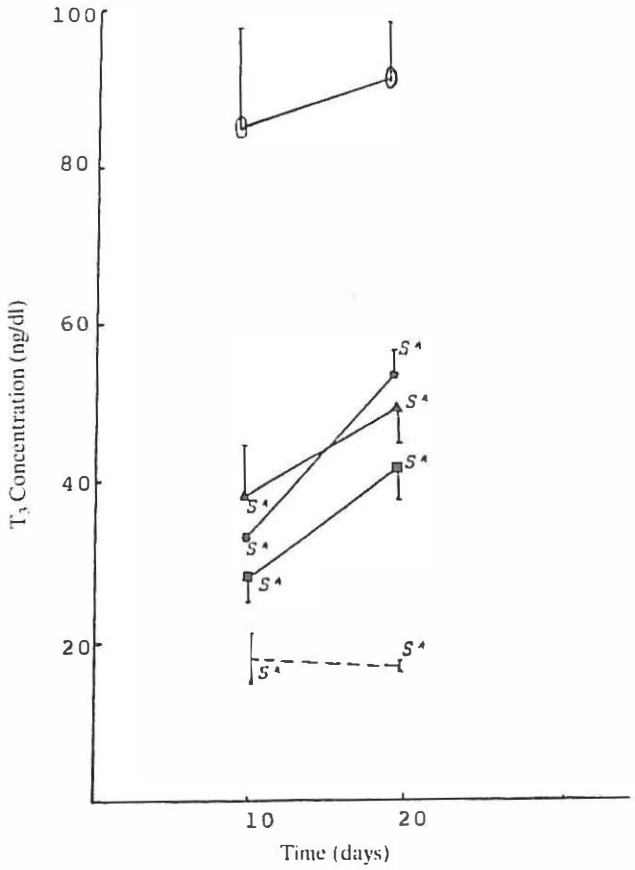

Figure 4. The effect of three different doses of *B. napus* autolysate on serum T_3 concentration after 10 and 20 days oral administration.

Serum T_3 concentration of control animals (○ – – ○) and animals fed with 20 mg/kg b.wt./representative of 8 gm seeds/kg b.wt./d. (▲ – – ▲) and 32 gm seeds/kg b. wt./d. (■ – – ■).

$S^{\$}$ = P<0.001

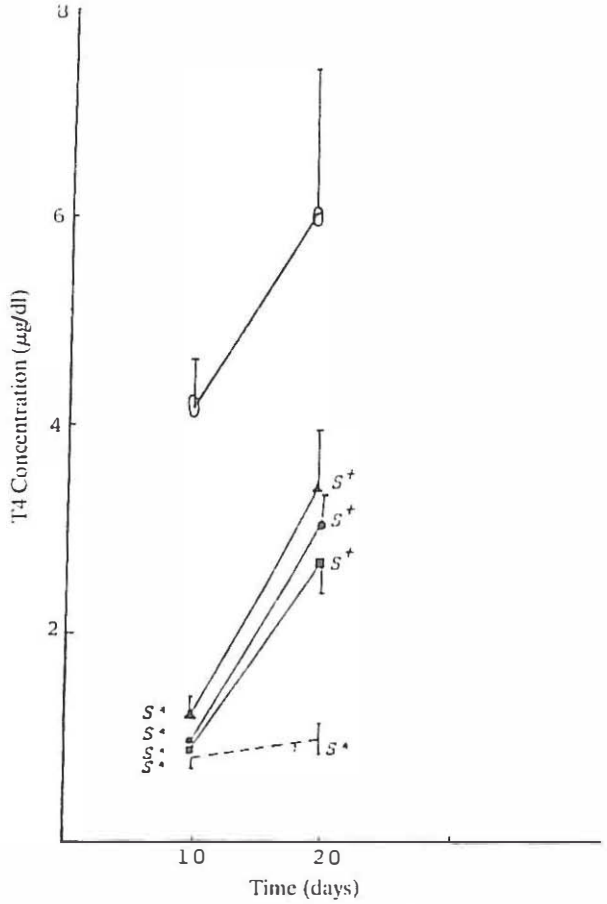

Figure 5. The effect of three different doses of *B. napus* autolysate on serum T_4 concentration after 10 and 20 days oral administration.

Serum T_4 concentration of control animals (● – – ○) and animals fed with 20 mg/kg b.wt./representative of 8 gm seeds/kg b.wt./d. (▲ – – ▲) 16gm seeds/kg b.wt./d. (● – – ●) and 32 gm seeds/kg b.wt./d. (■ – – ■).

S^{*} P<0.01, S^{*} = P<0.001

with a steep slope. The three different concentrations of *D.sophia* autolysate also reduced serum T_3 concentration in a similar fashion to that found with methimazole but to about one-fourth of its original concentration in 10 days. This reduction did not continue during the next 20 days, and serum T_3 concentration was increased until it reached its original concentration after 20 days.

Figure 3 shows the effect of three different doses of *D. sophia* autolysate on serum T_4 concentrations after 10, 20, and 30 days, compared with serum T_4 concentration of groups fed with methimazole, and groups fed with distilled water for the same intervals of time. The autolysate effect on serum T_4 concentration is more pronounced than that of methimazole during the first 10 days. However, this reduction also ceased when administration of the autolysate was continued for 20 days more.

Figures 4 and 5 show the effect of three different doses of *B. napus* autolysate on serum T_3 and T_4 concentrations after 10 and 20 days, compared with serum T_3 and T_4 concentrations in groups fed with methimazole, and groups fed with distilled water for the same intervals of time. The autolysate reduced serum T_3 and T_4 concentrations during the first 10 days, but during the next 10 days, the two hormones concentrations were elevated again though remaining significantly depressed in comparison to control values.

According to results obtained in this study, *D. sophia* and *B. napus* autolysates act as very potent antithyroid substances but for less than 30 days continuous consumption. If these plants act similarly in man, such an action can be considered as an advantageous property when thyroid gland depression is required briefly while preserving reversibility.

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