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INFLUENCE OF FEEDING CURDS FROM SOYABEAN MILK ON THE INTESTINAL SYNTHESIS OF THIAMINE IN RATS

B. R. BALIGA AND R. RAJAGOPALAN
Central Food Technological Research Institute, Mysore
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In our previous papers, experimental evidence was presented to show that supplementing curds from cow's milk to casein-starch diet fed to rats led to increased intestinal synthesis of thiamine[1,2] and this benefitted the host to a substantial degree when the intake of the vitamin was suboptimal[3].

The importance of soyabean milk in the dietary of oriental people need not be over emphasized. In recent years, attempts have been made to popularise vegetable milks in India as well. The usefulness and nutritive value of soyabean and groundnut milks have been demonstrated conclusively by the Bangalore group[4-7] and successful attempts have been made by this Institute to popularise groundnut curds[8].

As such, it was of interest to study the effect of supplementation of curds prepared from vegetable milk on the intestinal synthesis of thiamine in rats. Soyabean milk was used for these experiments as this protein, among the vegetable proteins, resembles closely casein, the predominant protein in cow's milk.

Experimental

30 rats weighing 60-65 g were divided into five groups following the usual conventions in regard to litter, sex and weight and fed according to the following schedule :

I Control group—Casein-starch diet
II Cow's milk group—Casein-starch diet+13 g. cow's milk/rat/day
III Cow's curds group—Casein-starch diet+13 g cow's curds/rat/day
IV Soyabean milk group— Casein-starch diet+13 g soyabean milk/rat/day
V Soyabean curds group—Casein-starch diet+13 g soyabean curds/rat/day.

The composition of the diet, vitamin supplement and the feeding schedule and other details were the same as stated in our previous experiment[2]. The food intakes of the four groups receiving supplements of milk and the corresponding curds was controlled. The thiamine intake was adjusted to half optimum i.e. 10 μg./rat/day. All the other vitamins were fed at the optimum levels. The excreta were collected during the last three days of each week.

The experiment was continued for six weeks, the rats being sacrificed at the end to collect livers for evaluation of thiamine storage. Thiamine in urine, feces and liver was estimated by thiochrome method of Mawson and Thompson[10] after concentration on zeolite[11,12]. The release and extraction of thiamine from feces and liver was carried out according to Kodicek and Wang[13] and Greenberg and Rinehart[14] respectively.

For the preparation of soyabean milk, clean soyabean seeds were soaked in water overnight and dehusked. Debittering was carried out by heating with three volumes of 0.1% sodium bicarbonate solution at 70-80°C for 15 min. Then the seeds were thoroughly washed and ground into a fine paste, was mixed with sufficient water and heated nearly to boiling and filtered through a fine cloth. The milk obtained was boiled well for 10 minutes and the solids were adjusted to about the same total solids as in cow's milk. Lactose was added at 0.9%. Curds were prepared from cow's milk and soyabean milk by seeding with a dilute suspension of cow's milk curds and incubating overnight at room tamperature.

Results and Discussion

Growth data : There is no difference between the gain in weight or food efficiency

Table I. *Growth response of rats on casein-starch diet to supplements of cow's milk, cow's curds, soyabean milk and soyabean curds*

Group	Initial weight (g)	Final weight (g)	Increase in weight (g)	Food intake (g)	Feed efficiency
Control	62	158	96	466	0 2068±0.0045
Cow's milk	62	175	113	513	0.2271±0 0039
Cow's curds	62	177	115	516	0 2222±0.0070
Soyabean milk	62	171	109	509	0 2143±0 0067
Soyabean curd	63	168	105	500	0 2094±0 0070

of the curds and the corresponding milk control. Comparing the overall control on casein-starch deit and the other groups fed milk or curds supplement, there is a slight difference in weight gained. But, on considering this with the food intake, there is no signifiicant difference as shown by the feed efficiency data. There is no difference between the group given supplements of cow's milk as well as the corresponding curds. The lack of significant differnce between the feed efficiencies of the control and the cow's curds group is in agreement with the similar observation in our previous report[2].

Urinary excretion : As in our previous report[2] the excretion of thiamine is higher in the group receiving supplement of cow's curds than in the control group on casein-starch diet. But there is no such increase in the group receiving supplement of cow's milk. Similarly there is no increase in excretion in the two groups receiving soyabean milk and curds.

Fecal excretion : The fecal excretion data closely parallel the urinary excretions of thiamine prevailing in the different groups. While the excretion in the group of rats receiving supplements of cow's curds is significantly more than the excretion in the control group, the excretion level in soyabean curds supplemented group does not differ from the control. Cow's milk and soyabean milk supplemented groups show the same pattern of excretion as in the control group.

Liver stores : The storage of thiamine in the group getting supplements of cow's curds is significantly higher than that in the control, while the stores in the groups getting cow's milk, soyabean milk and curds are not significantly different from the control. A similar relationship also holds good when the thiamine stores are expressed as/ug/g. fresh liver tissue.

Considering all the data together, it is apparent that supplementation of soyabean curds to rats on a casein-starch diet does not lead to increased intestinal synthesis of thiamine as is the case on supplementation of cow's curds.

The failure of soyabean curds to evoke a respouse similar to that shown on cow's curds supplementation is rather surprising and puzzling. The soyabean milk used to prepare the soyabean curds employed in the experiment contained added lactose and for the purposes of curdling an equal amount of dilute cow's curds suspension was used in the case of cow's milk as well as soyabean milk. Under these conditions the development of lactobacilli, lactic acid and curdling should be similar if not identical. The only difference between the two curds is that cow's curds is of a harder consistency than soyabean curds[7].

Table II. *Influence of feeding cow's milk, cow's curds, soyabean milk and soybean curds on the urinary excretion of thiamine in rats on casein-starch diet (in µg/day)*

Week	Control	Cow's milk	Cow's curds	Soyabean milk	Soyabean curds
I	1 45±0 02	1 31±0.04	2.01±0 03	1 36±0 06	1 33±0 06
II	1.35±0 03	1.28±0.04	2.00±0 06	1 39±0.05	1.45±0 05
III	1.46±0 02	1.53±0.03	2.16±0.03	1 45±0 05	1 50±0.03
IV	1.33±0.03	1.48±0.05	2.02±0.03	1.42±0.05	1.42±0.05
V	1.48±0.04	1 42±0.05	2.12±0 05	1 37±0.03	1.50±0.04
VI	1.38±0.04	1.39±0.05	2 20±0.02	1.45±0.05	1.53±0 03

Table III. *Influence of feeding cow's milk, cow's curds, soyabean mtlk and soyabean curds on the fecal excretion of thiamine in rats on casein-starch diet (in/μg/day)*

Week	Control	Cow's milk	Cow's curds	Soyabean milk	Soyabean curds
I	2.47±0.06	2.58±0.05	3.20±0.08	2.32±0.04	2 28±0.10
II	2.32±0.03	2.64±0 07	3.48±0.03	2.39±0.07	2.17±0.08
III	2.32±0.04	2.62±0.06	3.16±0.03	2.35±0.05	2 30±0.05
IV	2 50±0.06	2.68±0.01	3.34±0.02	2.33±0.05	2.29±0.07
V	2.44±0.03	2.86±0.06	3.25±0.04	2.33±0.07	2.35±0.07
VI	2.42±0.03	2.74±0.07	3.14±0.05	2.31±0.05	2.34±0.06

Table IV. *Influence of feeding cow's milk, cow's curds, soyabean milk and soyabean curds on the liver stores of thiamine in rats on casein-starch diet*

Group	Liver stores	
	Total (μg)	*(μg/g)*
Control	10.3±0.03	1.98±0.05
Cow's milk	10.3±0.50	1.89±0.08
Cow's curds	16.1±0.50	2.45±0.10
Soyabean milk	11.8±0.05	1.91±0.07
Soyabean curds	11.6±0.03	2.06±0 1

The only conclusion that could be drawn for the failure of soyabean curds to afford a better thiamine nutrition status through increased intestial synthesis is that the intake of viable lactobacilli is not the primer to increased intestinal synthesis occuring on supplementation of cow's curds to rats on a casein-starch diet.

Summary

The influence of feeding supplements of cow's milk and curds and soyabean milk and curds to rats on a casein-statch diet on the intestinal synthesis of thiamine has been invesigated. While a supplement of cow's curds produced increased intestinal synthesis and better thiamine nutrition status, cow's milk, soyabean milk or soyabean curds failed to evoke any such response, Based on these observations, it has bean concluded that lactobacilli developing during curdling are not the primers of the increased intestinal synthesis on cow's curds supplementation.

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