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THE INFLUENCE OF ENRICHMENT OF MAIZE MEAL ON THE GROWTH OF RATS.

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INTRODUCTION.

The ideal in the fortification of flour or meal would be to supplement with quality proteins, vitamins and minerals in such a way as to produce an adequately balanced diet.

However, in view of the obvious difficulties, such as costs, availability of suitable supplements and keeping qualities, a preliminary step may be the addition to the flour of those essentials which were lost in the process of milling. The nutritional value of the original whole meal would then be retained in the finely milled and palatable final product.

The question of the enrichment of maize products is most ably discussed in an Editorial (1947). The following is quoted from this article: "Moreover, there is a long recognized association of pellagra with diets in which corn (maize) predominates. This was attributed for several years entirely to the low niacin content of corn, now it is known that corn is low in tryptophane, which has come to be recognized as a precursor of niacin." Although milk is low in niacin, its tryptophane content reasonably accounts for the anti-pellagric effect, emphasized by Goldberger.

Several workers have contributed towards the artificial enrichment of white flour, viz. Salcedo (1950), Westerman (1949), and The National Research Council (1944, 1948).

A number of American States have based legislation for the enrichment of meal on the recommendations of workers whose aim is to replace essential nutrients lost in the process of milling The plan may be tabulated as follows:—

TABLE 1.

Comparative Values for Enriched and Non-enriched Bread.

	Non-enriched. (70% Ext.).	Enriched White.	Whole Wheat (100%).
Thiamin (mg.)	0·3	2·0– 2·5	2·5
Riboflavin (mg.)	0·15	1·2– 1·5	0·56
Niacin (mg.)	3·5	16·0–20–0	25·3
Iron (mg.)	3·0	13·0–16·5	173·0
Calcium (mg.)	86·0	86·0*	173·0
Protein (gm.)	49·0	49·0	59·0

* Calcium corrective to be made by adding 500 mg. per lb.

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Various vitamin and mineral concentrates are manufactured for enrichment of different products. These concentrates are generally blended with starch in such a way as to enable the constituents to be uniformly and easily mixed in bulk meals. One such enrichment concentrate called " Vextram " was used in growth studies on rats.

EXPERIMENTAL.

Two commercial maize products were procured for this work, (1) whole white maize meal (straightrun), and (2) white processed maize flour.

For each product two groups of adolescent albino rats were selected in such a way that the test could be carried out according to the paired feeding technique described by Spector *et al.* (1946). One group of six rats received the vitamin compound (Vextram) in their rations. In all there were four groups for the two products.

Each pound of enriched mixture contained: Thiamine mononitrate = 388 mg., (biologically equivalent to 400 mg. thiamine hydrochloride); Riboflavin = 240 mg., Niacin = 2,800 mg., and Iron (reduced electrolitically) as Fe = 2,400 mg. These vitamins and minerals are blended with starch, mono-calcium phosphate, tri-calcium phosphate and talc to produce a stable, free flowing mixture for the enrichment of maize meal. The prescribed quantity to be used is $\frac{1}{2}$ oz. per 100 lb. of maize meal.

The basal ration used had the following ingredients (parts per 100): alcohol-extracted casein 15, sucrose 20, salts (Hubbel *et al.*) 2, maize oil 2, fish liver oil 1, and cystine 0·1. The vitamins were incorporated at the following levels (mg. per 100 grams of ration): pyridoxine 0·25, calcium panthothenate 2·0, choline chloride 100, inositol 10, vitamin K (2-methyl-napthoquinone) 0·1; and folic acid 11·5 micro-grams. Alpha-tocopherol was given in the form of wheat germ oil at the level of 0·5 mg. per day.

Groups 1 and 2 received the basal ration plus 60 parts white maize flour, and Groups 3 and 4 received the basal ration plus 60 parts whole white maize meal.

Only Groups 2 and 4 were supplemented with " vextram " at the level of 244 mg. per 100 gram ration. This quantity of the supplement is based on the daily requirement of 1·5 mg. Niacin per 100 grams ration, according to Spector *et al.* (1946).

The growth of the individual rats of each group has been recorded and can be found in the summary below (tables 2 and 3).

DISCUSSION.

The highly significant statistical difference between groups 1 and 2 is indicative of the beneficial results obtained by adding 244 milligrams of " Vextram " compound to each 100 grams of maize flour. As the protein, mineral and calorific levels of the rations were kept constant, the growth stimulus must be attributed to the supplementation of thiamin, riboflavin and niacin in the vextram.

In view of the generally inadequate protein level of maize and as protein was not being tested, devitaminized casein was added to all rat rations.

The average weight gain in rats that received vextram while on a diet of flour was 3·19 grams (per week) more than where the vitamin supplement was not given. When they received whole maize meal and vextram the average weight gain was 2·59 grams more than for those rats on whole maize meal only. From the latter finding it may be concluded that it would be beneficial to fortify straightrun maize meal with certain of the B-complex vitamins. In the case of maize flour the advantages of enrichment are considerably increased. Apart from these advantages the supplemented rations enhanced the appetites of the rats. All animals in the respective groups where the small quantity of the vitamin mixture had been added, readily consumed their daily portions without fail. The rats of the control groups, however, showed loss of appetite at times.

TABLE 2.

Results of paired feeding tests:—

(White Maize Flour.)

Rat No.	Supplement to Basal Ration.	Feed Intake. Grams per Week.	Mean Gain in Weight. Grams per Week.	Difference in Gain. Grams per Week.
1	None	33·98	4·43	
7	Vextram	35·46	9·14	4·71
2	None	35·54	3·57	
8	Vextram	37·74	6·57	3·00
3	None	39·49	6·14	
9	Vextram	41·04	9·43	3·29
4	None	40·60	4·71	
10	Vextram	43·51	8·30	3·59
5	None	35·04	3·87	
11	Vextram	37·00	6·14	2·27
6	None	43·61	5·71	
12	Vextram	44·94	8·00	2·29
Mean	Control—			
	Group 1 (None)	38·05	4·74	
	Group 2 (Vextram)	39·95	7·93	3·19

The result of statistical analysis:—

The t-test applied to differences:—

	t.	n.	5%	1%
Group 1 and 2	8·6xx	5	2·57	4·032

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TABLE 3.

Results of paired feeding tests:—

(Whole White Maize Meal.)

Rat No.	Supplement to Basal Ration.	Feed Intake. Grams per Week.	Mean Gain in Weight. Grams per Week.	Difference in Gain. Grams per Week.
13	None	46·17	8·14	
19	Vextram	47·29	10·71	2·57
14	None	40·56	8·71	
20	Vextram	41·01	10·57	1·86
15	None	41·47	10·28	
21	Vextram	41·47	10·28	0
16	None	37·81	6·86	
22	Vextram	39·31	9·14	2·28
17	None	50·84	7·28	
23	Vextram	54·13	11·71	4·43
18	None	59·83	10·00	
24	Vextram	64·04	14·43	4·43
Mean	Control—			
	Group 3 (None)	46·11	8·55	
	Group 4 (Vextram)	47·87	11·14	2·59

The result of statistical analysis:—

The t-test applied to differences:—

	t.	n.	5%	1%
Group 3 and 4	3·8x	5	2·57	4·032

SUMMARY.

Maize products are notoriously deficient in certain essential nutrients, amongst others, some members of the B-complex vitamins. Such deficiencies are furthermore aggravated in processing maize.

Two maize products, one a whole white maize meal and the other a white maize flour (processed) were studied. These maize products were incorporated in balanced rations enriched with a vitamin product known to contain some of the essential members of the B-complex vitamins. Growth tests using adolescent albino rats were carried out. The results clearly indicated the beneficial effect of the supplementation.

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