

THE STABILITY OF PYRIDOXINE ADDED TO CEREALS¹

W. R. BUNTING

ABSTRACT

The retention of natural plus added vitamin B₆ was 90 to 95% in corn meal and 100% in macaroni on shelf storage for 1 year at 100°F. and 50% relative humidity. When corn meal was cooked to corn bread, 100% of the vitamin B₆ was recovered. When macaroni was cooked, about 50% of the vitamin B₆ was found in the cooked macaroni and 50% in the drained cooking water. This loss of vitamin B₆ in the drained water is similar to the loss of thiamine in the cooking of enriched macaroni.

Bradley² has shown that the natural vitamin B₆ content of U.S. diets is lower than previously believed. The Food and Nutrition Board (1,2) has increased its tentative recommended daily allowance of 1 to 2 mg. pyridoxine to 1.5 to 2 mg. The sufficiency of vitamin B₆ intake in fulfilling needs is seriously questioned. Bradley (personal communication) and Borsook (3) recommend the addition of pyridoxine to increase the intake. Harris (4) and the Food and Nutrition Board (2) recommend further investigations of both intake and need.

This study was undertaken to determine the stability of pyridoxine hydrochloride in degerminated corn meal and macaroni under normal storage conditions and to determine losses during cooking in order to evaluate the practical problems which would be encountered in an enrichment program.

Materials and Methods

Pyridoxine hydrochloride was added to enriched degerminated white corn meal and to enriched elbow macaroni at the level of 2.2 mg./lb. This level of addition was chosen arbitrarily for this study and was not intended to imply a recommended level of addition. For addition to the corn meal, the pyridoxine was first mixed into a small premix with corn meal, then into a batch totaling 30 lb., in a ribbon mixer. The pyridoxine was added to the macaroni flour, then processed into macaroni, in a small plant-size batch. The two products, with controls containing no added pyridoxine, were packaged in small commercial-type cartons.

The vitamin B₆ analyses were made by the *Saccharomyces carlsbergensis* method (5). Variations in analytical values in this study are

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²Bradley, W. B. Personal communication to author, 1960.

similar to many of the variations found in an AOAC collaborative study of this method (6).

The corn bread was made according to the following recipe, commonly used in southern U.S.A.

- 1.5 cups white corn meal
- 3 tablespoons enriched flour
- 1 teaspoon salt
- 1 teaspoon soda
- 2 cups buttermilk
- 1 egg
- 2 tablespoons butter

Sift dry ingredients into bowl. Add buttermilk and egg, stirring until combined. Melt butter and add to batter. Pour batter into very hot skillet. Bake in very hot oven (450°F.) 20 to 25 min.

Pyridoxine was determined in the batter and final product at three different times. Controls were tested at two different times.

The expected vitamin B₆ levels in the batter were calculated from the found levels in the corn meal and the following literature values: 0.3 mg./lb. for the flour (Bradley, personal communication), 0.54 mg./lb. for the egg (3), and 0.18 mg./lb. for milk (3). For this purpose the literature value for milk was assumed to be the same for the buttermilk.

The macaroni was prepared using this recipe:

- 7 oz. macaroni
- 8 cups boiling water
- 1½ teaspoons salt

Stir macaroni into rapidly boiling salted water. Continue boiling uncovered for 12 to 14 min., stirring occasionally. Drain well.

The pyridoxine content of cooked macaroni and of the water drained from the cooked macaroni was determined in five test samples and three controls, containing no added pyridoxine.

Results and Discussion

The stability of pyridoxine hydrochloride added to degerminated corn meal and to macaroni was excellent. This conclusion applies both to stability in storage and to cooking.

In storage, 90 to 95% of the added pyridoxine plus the natural vitamin B₆ was recovered from the enriched corn meal and 100% from the enriched macaroni (Table I), after 1 year at 100°F. and 50% relative humidity.

In the baking of degerminated corn meal to corn bread, about 100% of the natural and added vitamin B₆ was retained (Table II). In a similar test in the baking of bread, Bradley (personal communication) found 82 to 100% retention of vitamin B₆.

TABLE I
STABILITY OF VITAMIN B₆ IN DEGERMINATED CORN MEAL AND MACARONI TO SHELF STORAGE AT 100° F. AND 50% RELATIVE HUMIDITY (Pyridoxine hydrochloride added to products at 2.2 mg./lb.)

STORAGE TIME	DEGERMINATED CORN MEAL		MACARONI	
	Found	Retention	Found	Retention
<i>months</i>	<i>mg./lb.</i>	<i>%</i>	<i>mg./lb.</i>	<i>%</i>
0	3.9	..	2.6	..
1	3.6	92	2.4	92
3	3.2	82	3.0	115
6	3.5	90	2.4	92
12	3.7	95	3.0	115

TABLE II
STABILITY OF VITAMIN B₆ DURING BAKING OF CORN MEAL TO CORN BREAD.^a

CORN MEAL		BATTER		WEIGHT RATIO, BATTER TO CORN BREAD	CORN BREAD		RETENTION
Added	Found	Expected ^b	Found		Calculated ^c	Found	
<i>mg./lb.</i>	<i>mg./lb.</i>	<i>mg./lb.</i>	<i>mg./lb.</i>		<i>mg./lb.</i>	<i>mg./lb.</i>	<i>%</i>
0	1.52	0.54	0.55	1.21	0.67	0.72	107
2.2	3.89	1.16	1.24	1.17	1.45	1.50	103

^a Average of two bakes of corn bread from corn meal without added pyridoxine and three bakes with added pyridoxine.

^b Expected vitamin B₆ level was calculated from the found levels in the corn meals and literature values of the flour, egg, and milk.

^c Calculated from found levels in the batter and weight ratios of batter to corn bread.

After the macaroni was cooked, about 50% of the natural plus added vitamin B₆ remained with the macaroni and 50% with the drained cooking water (Table III). This loss in the cooking water is similar to the loss of thiamine in the cooking of enriched macaroni. To allow for losses in the drained water, the statements on the labels of enriched macaroni and noodle products claim 50% of the thiamine, 70% of the riboflavin, 60% of the niacin, and 100% of the iron which must be present in the packaged uncooked products to fulfill the Federal Standards of Identity.

TABLE III
STABILITY OF VITAMIN B₆ DURING COOKING OF MACARONI^a

MACARONI, UNCOOKED		MACARONI, COOKED AND DRAINED		DRAINED COOKING WATER		TOTAL RECOVERY
Added	Found	Found ^b	Recovery	Found ^b	Recovery	
<i>mg./lb.</i>	<i>mg./lb.</i>	<i>mg./lb.</i>	<i>%</i>	<i>mg./lb.</i>	<i>%</i>	<i>%</i>
0	0.54	0.28	52	0.28	52	104
2.2	2.62	1.20	46	1.33	51	97

^a Average of three cookings of macaroni without added pyridoxine and five cookings with added pyridoxine.

^b The found vitamin B₆ levels of the macaroni cooked and drained and of the drained cooking water are expressed as mg./lb. of the original uncooked macaroni.

In conclusion, the addition of pyridoxine hydrochloride as an enrichment nutrient to corn meal or macaroni presents no problems, with the exception of the 50% loss of vitamin B₆ in the drained water from cooked macaroni.

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