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AVAILABILITY OF CALCIUM IN BAGOONG ALAMANG DRIED ALAMANG, CANNED BANGOS OYSTER SHELL, AND BALUT[1]

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ONE TEXT FIGURE

INTRODUCTION

Calcium occupies a prominent place in the human body's mineral composition. Since it is essentially useful in the maintenance of bones and teeth, most of it is found in the bony skeleton. It is not found in the same proportion in all foods. Many of the foods commonly liked by people are entirely lacking in calcium or contain small amounts of it. The Oriental diet is poor in calcium. This is typically true of the Filipino who generally lives on cereals, fish, and vegetables. Calcium-deficient diets have also been noted in the United States, England, Scotland, and other European countries (Bogart, 1949). This paper intends to acquaint the people with some food products which are good sources of available calcium. The products under investigation are common, cheap, and easily obtainable by the average family and thus would be considered good substitutes for milk which is an excellent source of calcium but an expensive item in the diet.

[1] This investigation was performed at the Bio-assay Laboratory of the Bureau of Fisheries at Dagatdagatan Experimental Station, Malabon, Rizal Province.

Bagoong alamang, a fermented semisolid paste obtained by salting small shrimps, is generally used as condiment for flavoring various vegetable, fish, and meat dishes. Dried alamang is a favorite of housewives for improving the flavor and rendering leafy vegetable dishes palatable. Balut,[2] considered a nutritious food among some Filipinos, is quite expensive but is a good source of protein and vitamins besides calcium. The bones from canned bañgos present another good source of available calcium. Oyster shell has not yet met extensive public demand as a source of calcium for poultry, fish, and other animal feed although it is cheap and easily obtainable.

Table 1 gives the chemical analysis of the foods used as sources of calcium in the experimental diets. This table shows that bagoong alamang and dried alamang contain appreciable amounts of calcium.

TABLE 1.—*Chemical analysis of dried alamang, bagoong alamang, canned bañgos, balut, and oyster shell.*

	Bagoong alamang	Dried alamang	Bañgos	Balut	Oyster shell
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Moisture	65.7	13.42	73.9	70.8	----------
Protein	12.3	59.33	20.3	14.4	----------
Fat	2.1	----------	4.5	12.4	----------
Ash	18.4	8.37	1.30	1.10	----------
Carbohydrates	1.5	----------	----------	0.9	----------
Calcium	2.071	3.33	2.75	0.117	46.84

REVIEW OF LITERATURE

Considering the fact that in the Philippines milk and other dairy products are luxury items in the diet, and that a comparatively large amount of calcium is necessary for optimum health, Navarro (1950) made experiments on the availability of calcium in two typical and widely used fish products, namely, salted fish paste (*bagoong*) and dried anchovies or *dilis* (*Stolephorus commersoni*). She found that the retention of calcium from dilis is approximately 90 per cent that of milk powder and only 62 per cent in bagoong.

Leverton and Payawal (1951) worked on the physiological availability of calcium, phosphorus, and nitrogen from the bones and flesh of dilis using human subjects. They reported that girls from 9½ to 13 years of age can utilize the calcium,

[2] Balut is an embryonated duck egg whose development is arrested by cooking.

phosphorus, and nitrogen from the bones and flesh of dilis as well as from milk.

Basu et al. (1942) performed calcium and phosphorus balance experiments in small fish bones using human subjects, and found that about 45 per cent of the calcium and 44 per cent of the phosphorus of small unboned fish was retained. They further emphasized that eating small fish complete with the bones as practiced in India, Philippines, and other Oriental countries increases the available calcium in the diet.

Feeding experiments on rats performed by Lunde and Like (1940) using fish, fish bones, and milk as sources of calcium revealed that the per cent utilization in milk, canned sardines, and fresh brisling were 93.8, 92.1, and 94.7, respectively. The U. S. Bureau of Fisheries also reported that the calcium in the bones of canned salmon is nutritionally available.

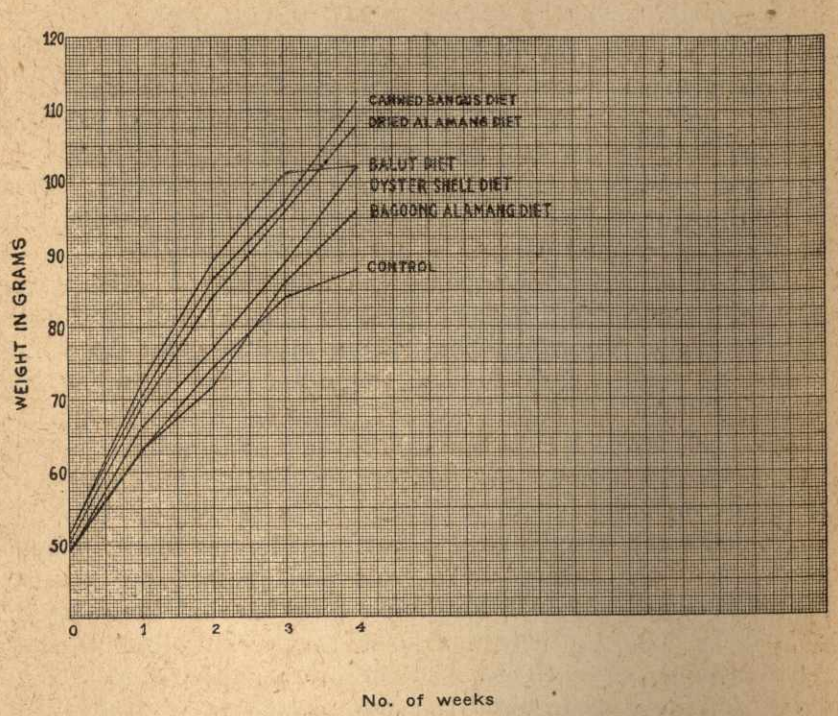
Drake et al. (1949) compared the utilization of calcium in skim milk powder and in bone meal by humans and concluded that the availability of calcium in bone meal is about the same as that of milk. They further found that the retention of calcium from whole cooked ground bones by rats was approximately 90 per cent over that from whole dried milk.

Other workers have also performed various bio-assay experiments on the availability of calcium in some typical foods. McCluggage and Mendel (1918) performed experiments which showed that the calcium of carrots and spinach are poorly utilized by dogs. In 1938 Fairbanks reported that the calcium in spinach is not utilized in the animal body. Adolph and Chen (1932) found that soy bean curd, the product from which the *tahu* and *tokua* of most Philipine markets are manufactured, is about equal to milk as a source of calcium.

EXPERIMENTAL PROCEDURE

This experiment utilized the procedure developed by Drake et al. (1949) on the utilization of calcium in bone meal by rats. Healthy albino rats, about 28 to 30 days old and weighing about 49.9 grams each, were selected for the assay. The rats were arranged so that litter mates of the same sex were matched and that the initial weights of each of the six groups in the experiment were approximately the same. The rats were placed in separate cages with raised screen bottoms under which paper towels were placed to prevent the loss of spilled food.

Calcium in the form of the substances to be tested was added to five of the experimental dietary groups. The sixth group containing a small amount of calcium probably due to the presence of casein in the diet, was used as control. A basal ration devised by Robertson and Doyle (1935) was used.



TEXT FIG. 1. Growth curve of rats fed with the different experimental diets.

This diet contained low calcium but the other elements like phosphorus were normal. The salt mixture used was devoid of calcium salts. The composition of the experimental diets together with their calcium contents is shown in Table 2.

Six groups containing 10 rats each were formed. Groups I to V were fed the experimental diets containing calcium in the form of bagoong alamang, dried alamang, canned bangos, oyster shell, and *balut*. These products were dried thoroughly in an oven at 70°C., and then ground finely to pass through a No. 40 mesh sieve. After reduction to fine powder, they were mixed thoroughly with the basal rations. All the experimental rations were prepared in sufficient quantities to last

TABLE 2.—*Composition of diets and their calcium contents.*

Ingredients	Percentage of dietary rations					
	Bagoong alamang diet	Dried alamang diet	Canned bañgos diet	Oyster shell diet	Balut diet	Control diet
Casein	16.4	17.0	16.7	18.0	15.7	18.0
Cornstarch	56.7	58.7	57.6	61.7	54.1	62.2
Purico	9.1	9.4	9.3	10.0	8.7	10.0
Yeast	5.5	5.7	5.6	6.0	5.2	6.0
CLO	1.8	1.8	1.8	2.0	1.7	2.0
Salt mixture *	1.6	1.7	1.6	1.8	1.6	1.8
Bagoong alamang	8.9					
Dried alamang		5.7				
Canned bañgos			7.4			
Oyster shell				0.5		
Balut					13.0	
Calcium	0.178	0.208	0.306	0.147	0.086	0.04

* Salt mixture	Weight (*Gram*)	Weight (*Gram*)
H_2HPO_4		219.72
KCl		125.29
NaCl		77.41
$MgCO_3$		33.43
$MgSO_4$		38.50
KI	.30	
$K_2Al_2(SO_4)_4 \cdot 24\ H_2O$	.67	
$MnSO_4$	1.17	
		13.80
NaF	3.68	
Fe citrate 1–1/2 H_2O	94.18	

the whole period of the experiment. They were placed in stoppered glass containers and kept under refrigeration.

The food and water were given *ad-libitum* for a period of four weeks, during which time an accurate record of the food consumed by each rat was taken. Any spilled food was saved and weighed to get the accurate amount of food eaten by each rat. The animals were weighed regularly every week. Close observations were made daily on the health and physiological behaviour of the experimental animals.

At the end of the assay period the final weights of the animals were taken, then they were killed with chloroform. All food adhering to the fur, tail, and other parts of the body was carefully removed. The rats were dissected through the abdominal cavity, and the stomach and intestines were discarded to eliminate the inclusion of food particles. According to Kao, Conner, and Sherman (1937) the calcium found in the walls of the intestinal tract is negligible. Since blood contains minute quantities of calcium, precautions were taken to avoid loss of blood during the dissection.

The actual weights of the carcasses were carefully taken and used as the basis of all calculations. The group weights were taken, then the carcasses were placed in suitable glass containers, covered with three per cent acetic acid, and processed in the autoclave for a period of 4 hours at 15 pounds steam pressure. This process rendered the fur, bones, teeth, and flesh soft, so that they were easily homogenized in the Waring Blendor. The homogenized mixtures were weighed and samples were taken for calcium analysis. The method used by the Association of Official Agicultural Chemists (1945) for calcium analysis was followed. To determine the exact calcium intake of each, the experimental diets were analyzed for their calcium contents. Results of analysis are found in Table 5. The composition of the experimental diets and their calcium contents are shown in Table 2.

RESULTS AND DISCUSSION

Rats fed with canned bañgos, dried alamang, and balut diets showed normal gain in weight and appeared to be in good health throughout the assay period. Table 4 shows that the rats fed with the canned bañgos ration had a remarkable gain in weight until the end of the assay period as compared to the other groups. The control rats and those fed with bagoong alamang diet were apparently in poor health, and exhibited only a slow gain in weight which could be attributed to loss of appetite. These rats were physically inactive and slow to respond to external influences during the course of the assay period. Rats fed with the oyster shell ration showed slow gain in weight at the start of the assay period but indicated a substantial gain at the end of the experiment.

TABLE 3.—*Growth and food consumption of rats on the various diets.*

Number of rats	Supplement	Average food intake[a]	Weight		
			Initial	Final	Gain
		gm.	*gm.*	*gm.*	*gm.*
10	None	161.9	49.7	88.0	39.3
10	Bagoong alamang	178.2	49.9	96.3	46.4
10	Dried alamang	174.0	50.1	108.0	47.9
10	Canned bañgos	195.3	50.8	111.8	61.0
10	Oyster shell	180.6	49.7	104.1	54.4
10	Balut	182.9	49.7	102.3	52.6

[a] Average food intake for the total experimental period.

To determine the significance of calcium on the rate of growth a comparison of the average weekly weights of the rats was made (fig. 1). Rats fed with the canned bañgos diet showed the greatest gain in weight at the end of the experimental period. Following in their order were those fed with dried alamang, balut, oyster shell, and bagoong alamang. As shown in Table 3 rats fed with canned bañgos diets had the greatest food intake. It was also observed that the rats fed with bagoong alamang and oyster shell diets together with the control rats showed general body weakness coupled with lessened activity and susceptibility to hemorrhages.

TABLE 4.—*Average weekly weights in grams of rats fed with different experimental diets.*

Group number	Initial weight in gms.	Number of weeks			
		1st week	2d week	3d week	4th week
I (Control)	49.7	63.2	74.8	84.1	88.0
II (Bagoong alamang)	49.9	63.2	72.0	86.2	96.3
III (Dried alamang)	50.1	69.2	84.5	96.3	108.0
IV (Canned bañgos)	50.8	70.3	87.9	97.4	111.0
V (Oyster shell)	49.7	66.5	77.6	89.2	102.0
VI (Balut)	49.7	72.3	89.3	101.7	102.3

It is evident from Table 5 that the rats given the canned bañgos diets exhibited the greatest percentage of calcium retention. The calcium of dried alamang and balut used in this experiment was utilized almost to the same degree as that of balut. The rats fed with the bagoong alamang diet stored the least amount of calcium. It is interesting to note that dried alamang contains a greater percentage of available calcium than bagoong alamang in spite of the fact that they are both prepared from the same species of crustacean, differing only in their methods of preparation.

TABLE 5.—*The retention of calcium by the rats.*[a]

Calcium supplement	Total calcium consumed	Calcium supplied by supplement	Total calcium in rats	Additional calcium retained by supplemented animal	Supplementary calcium retained
	mgm.	*mgm.*	*mgm.*	*mgm.*	*Per cent*
Bagoong alamang	317.0	249.0	569.0	117.0	47.0
Dried alamang	363.0	295.0	691.0	239.0	81.0
Canned bañgos	597.0	529.0	896.0	444.0	83.90
Oyster shell	266.0	198.0	584.0	132.0	66.7
Balut	157.0	89.0	524.0	72.0	80.9
Control	68.0	----------	452.0	----------	----------

[a] Figures in the table represent the average of the result.

The low percentage of calcium retention in bagoong alamang diet may be due to the presence of big amounts of salt and possibly the formation of insoluble calcium compounds as a result of the combination of calcium with fermentation products. No conclusion, however, could be deduced from this assumption. Retention of calcium in oyster shell diet was evidently better than that of the bagoong alamang. The average percentages of calcium retention for canned bangos, dried alamang, balut, bagoong alamang, and oyster shell are 83.9, 81.0, 80.9, 66.7, and 47.0, respectively.

SUMMARY AND CONCLUSIONS

Six groups with ten rats each were fed experimental diets containing calcium in the form of bagoong alamang, dried alamang, canned bangos, oyster shell, and balut. The sixth constituted the control group. Water and food were given *ad libitum*. Regular weekly weights were taken and observations were made daily on the health and physical behavior of the experimental animals. At the end of the assay period the animals were killed with chloroform, dissected to remove the stomach and intestine, processed wholly in the autoclave, homogenized, and samples examined for calcium analysis.

The following conclusions are made from the results of the experiment:

1. Percentage retention of calcium for the different products tested are the following: canned bangos, 83.9; dried alamang, 81.0; balut, 80.9; oyster shell, 66.7; and bagoong alamang, 47.0.
2. Canned bangos or dried alamang can be considered good dietary supplements for milk as a source of calcium.
3. Bagoong alamang is the poorest dietary source of calcium when fed under the conditions of this experiment, although it may serve as a good source of protein and phosphorus in the Filipino diet.
4. Considering the percentage of calcium retention in oyster shell, this product has excellent possibilities as a supplement for poultry feed.

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ILLUSTRATION

TEXT FIGURE

Fig. 1. Growth curve of rats fed with the different experimental diets.