TULYA (CORBICULA MANILENSIS PHILIPPI), PAROS (SOLETELLINA ELONGATA LAMARCK) AND OYSTER AS GOOD SOURCES OF AVAILABLE CALCIUM

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ONE TEXT FIGURE

INTRODUCTION

Most minerals in the Filipino diet are derived from vegetables and certain fishery products. This is true particularly with the majority of low-income families who subsist mainly on rice and dried fish and sometimes on seaweeds and shellfish. Common examples of shellfish found in certain localities in the Philippines are shrimps, crabs, oysters, tulya (*Corbicula manilensis Philippi*), and paros (*Soletellina elongata* Lamarck). The local markets in the Manila Bay area are sufficiently supplied with these products at certain times of the year. In general, they cost less than other food materials. In view of their easy availability in the market and considering their low cost compared to other foods, this experiment was planned to determine the part they play in the nutrition of the average citizen with reference to calcium availability. Among the mineral elements, calcium needs more attention in considering food value and food supplies from the viewpoint of meeting nutritional needs as it makes up a large proportion of the bones which compose the structural framework of the body.

Very few data are available in the literature concerning works on the nutritive quality of shellfish. Investigation performed by Miller and Robins (1940) on *opihi*, a Hawaiian mollusk, shows that it is a good dietary source of protein, calcium, and iron. Nilson (1950) reported that the nutritive value of certain fisheries products is at least equal to those from various species of farm animals, poultry and other fisheries products, Bersamin et al. (1955) and Navarro (1950).

The materials used in this study are meats of oyster (*Ostrea iredalei* Faustino), paros, and tulya, separated from the shells. The oyster was supplied from the Binakayan Oyster Farm, Binakayan, Kawit, Cavite Province, while tulya and paros were obtained from Malabon Central Market, Malabon, Rizal Province.

TABLE 1.—*Proximate and mineral analysis of paros, oyster, and tulya.*

	Tulya [a]	Oyster [a]	Paros [b]
	Per cent	*Per cent*	*Per cent*
Moisture	79.9	87.6	73.7
Protein	9.1	6.8	18.2
Fat	2.1	1.3	
Carbohydrates (by difference)	6.4	3.3	
Ash	2.5	1.0	3.4
Calcium	0.262	0.59	0.42
Phosphorus	0.162	0.143	0.238

[a] Data taken from Food Composition Tables, recommended for use in the Philippines, Handbook No. 1, April 1951.

[b] Analysis performed at the Chemistry Research Laboratory, Dagatdagatan Salt-water Fishery Experimental Station, Malabon, Rizal.

EXPERIMENTAL PROCEDURE

The method followed in this investigation was the same as that previously described by Drake et al. (1949) in their work on the utilization of calcium in bone meal by rats. Healthy albino rats about four weeks old, each with an average initial live weight of 52.5 grams to 52.7 grams were used in this experiment. The experimental animals were selected so that each group was represented by an equal number of males and females. Individual rats were housed in screen cages that were fitted with screen floors. Absorbent paper was placed under each cage to prevent the loss of any spilled food.

A basal ration of very low calcium content, devised by Robertson and Doyle (1935), was used. This low calcium diet contains phosphorus and other elements in normal amounts. No calcium salt was added to the salt mixture preparation.

Three of the four experimental diets were so prepared as to contain calcium in the form of the substances to be tested. The fourth experimental diet served as control. The very little amount of calcium present in the control diet can be attributed to the casein and cornstarch used in the diet preparation. Table 2 shows the composition of the experimental diets. It also gives the amount of calcium present in each diet.

Twenty-four rats were allotted into four groups of six animals each. Groups I, II and III subsisted on diets containing calcium in the form of *tulya*, *paros* and oyster, respectively. Group IV was fed the control diet. The meat portions of the shellfish were thoroughly separated from the shells, dried in an oven at 70°C. and ground finely to pass through a No. 40-mesh sieve. The prepared diets were placed in glass containers and stored in a refrigerator.

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

Ingredients	Diets			
	Tulya	Paros	Oyster	Control
	Per cent	*Per cent*	*Per cent*	*Per cent*
Casein	13.9	10.0	11.7	18.0
Cornstarch	54.8	58.6	52.9	62.2
Purico	10.0	10.0	10.0	10.0
Yeast	6.0	6.0	6.0	6.0
Cod Liver Oil	2.0	2.0	2.0	2.0
Salt Mixture [a]	1.8	1.8	1.8	1.8
Tulya	11.5			
Oyster		15.6		
Paros			11.6	5.0
Calcium	0.122	0.244	0.108	0.034

[a] Salt mixture

	Weight (gm.)		Weight (gm.)
K_2HPO_4			219.72
KCL			125.29
NaCl			77.41
$MgCO_3$			33.43
$MgSO_4$			38.50
KI	0.30		
$K_2Al_2(SO_4)_4\ 24H_2O$	0.67		
$MnSO_4$	1.17	–13.80	
NaF	3.68		
Fe citrate $1\frac{1}{2}$ H_2O	98.18		

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

Rats	Supplement	Average food intake [a]	Weight in grams					
			Initial	1st week	2nd week	3rd week	4th week	Gain
		(gm.)						
6	Tulya	177	52.7	76.9	89.1	100.6	108.3	55.6
6	Paros	182	52.5	78.2	90.8	97.1	104.6	52.1
6	Oyster	194	52.7	75.8	91.3	104.2	114.2	61.5
6	Control	153	52.5	71.5	83.5	88.5	88.6	34.1

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

Food and distilled water were given freely for twenty-eight days and food intake of each animal was carefully recorded. To obtain accurate record of the food consumed by each rat, any spilled food was separated from the feces and weighed. The animals were weighed at regular intervals and daily observations were made on the gross appearance and activity of each.

All experimental animals were weighed and killed with ether at the end of the assay period. The dead rats were carefully dissected through the abdominal cavity, the gastro-intestinal tracts were discarded, the furs brushed, and the tails washed

to prevent the possible inclusion of food particles. The carcasses belonging to the same group were placed each in suitable containers, covered with 3 per cent acetic acid and autoclaved for four hours at 15 lbs. pressure. The softened carcasses were homogenized in a Waring Blendor. The homogenized mixtures were then carefully weighed. These weights were used as the basis of all calculations. Samples were removed from each group for calcium analysis. The procedure followed for calcium analysis was that of the Association of Official Agricultural Chemists (1945). To have an accurate amount of calcium intake of the animals, the calcium content of each diet was also determined.

RESULTS AND DISCUSSION

The figures from the chemical composition of oyster, tulya and paros, presented in Table I indicate that all the three materials are good sources of calcium. It also shows a high percentage of protein in paros compared to oyster and tulya. The high amount of nutrients contained in paros can be attributed to its low moisture content.

In general, all rats fed the supplemented regimens grew very well and appeared to be in good health till the close of the assay period. In the attempt to determine the effect of calcium on the rate of growth, a comparison of the average weekly weights of the experimental animals was made. Figure I clearly shows that the average growth rate of the rats receiving the oyster diet was superior to that of the other animals. The growth rate of the tulya and paros-fed animals were almost as good as those on the oyster diet. The rats that consumed the low-calcium diet manifested a slow gain in weight. Cessation of growth among these animals was observed during the last week of feeding.

The growth cessation of the calcium-deficient rats can be attributed to a large extent to anorexia. As shown in Table 4, their food consumption is less than those of the other experimental groups. Table 4 also reveals the magnitude of the average gain in weights of the rats after 28 days on the experimental ration. The calcium-deficient rats indicated the smallest gain in weight. Consequently, they appeared unhealthy in over-all appearance, very inactive, and showed no interest in the things around them. In marked contrast, the supplemented-diet fed animals showed no physiological disturbance and were found to be healthy and very active.

Data on the calcium retention of the rats on the supplemented diets are summarized on Table 4. The greatest calcium retention was manifested in rats fed the tulya diet. The results so

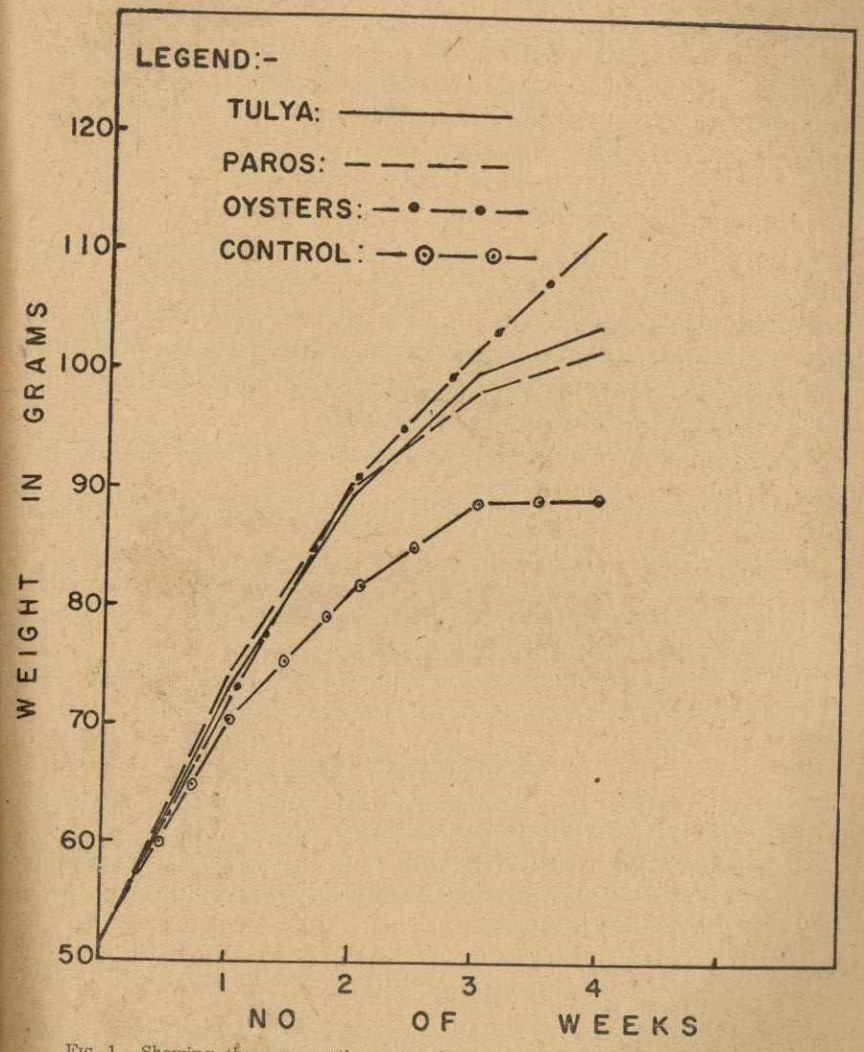

Fig. 1. Showing the comparative rate of growth of rats fed the various diets.

far demonstrate that calcium retention of rats subsisting on the oyster diet almost compares with that of the paros-fed rats. The average percentages of calcium retention for tulya, paros and oysters are 89.4, 82.7, and 80.6, respectively.

TABLE 4.—*The retention of calcium by the rats.*

Calcium supplement	Total Ca consumed	Ca supplied by supplement	Average Ca in rats	Additional Ca retained by supplemented animal	Additional Ca retained by supplemented animal
	mg.	*mg.*	*mg.*	*mg.*	*Per cent*
Tulya	239	189	558	167	89.4
Paros	196	145	511	120	82.7
Oyster	411	360	681	290	80.6
Control	51	----------	391	----------	----------

SUMMARY AND CONCLUSION

Twenty-four young, healthy albino rats with an average initial live weight of about 52.5 to 52.7 grams were fed individually for twenty-eight days on a calcium-deficient diet and diets containing calcium in the form of dried tulya, paros and oyster meats. Amount of calcium utilized was determined by calcium analysis of the rat carcasses.

The following conclusions can be drawn from the results reported in this experiment:

1. The calcium in tulya is definitely better utilized than the calcium of oyster and paros.
2. Under the condition of this experiment, tulya, oyster and paros can be considered as important sources of available calcium in the diet of the Filipino people.
3. The average percentages of calcium retention for tulya, paros and oysters are 89.4, 82.7 and 80.6 respectively.

LITERATURE CITED

Association of Official Agricultural Chemists. 1945. Official and Tentative Methods of Analysis, sixth ed., Washington, D. C., p. 119.

BERSAMIN, S. V., O. N. GONZALEZ, and J. I. SULIT. 1955. Availability of calcium in bagoong alamang, dried alamang, canned bangos, oyster shell, and balut. In press.

DRAKE, T. H., S. H. JACKSON, F. E. TISDALL, W. M. JOHNSTON, and L. M. HURST. 1949. The biological availability of calcium in bones. Jour. Nutrition 37: 369–376.

MILLER, C., and R. ROBINS. 1949. Chemical analysis and vitamin assays of opihi, the hawaiian limpet. Phil. Jour. of Sci. 71: 141–161.

NAVARRO, O. B. 1950. Availability of calcium in bagoong and dilis. Bull. Fish. Soc. Phil. 1 Comm. issue, 37–46.

NILSON, W. 1950. Fishery products as a source of animal protein. Comm. Fish. Review 13 No. 5: 6–9.

ROBERTSON, E. C., and M. E. DOYLE. 1935. Intestinal stasis in low mineral diets. Jour. Nutrition, A. 553–567.

ILLUSTRATION

TEXT FIGURE

FIG. 1. Showing the comparative rate of growth of rats fed the various diets.