Effect of a Protein Dietary Supplement on Muscular Strength and Hypertrophy

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IN RECENT years emphasis has been placed on the importance of protein supplements to the diet of those seeking increased muscular strength and hypertrophy. Their actual value, however, has been seriously questioned by nutritionists. Kline, for example, has written:

"It is not difficult to believe that labeling and advertising of some of the special protein food products contain implications that are likely to be misleading, if not actually untrue. Any suggestion that the diet of the average person in the United States does not provide adequate protein is in this category."[1]

It is the general opinion of students of nutrition that wide variations in protein intake are without effect on the physical fitness of young men, and that the growth of the muscle mass cannot be increased by feeding subjects a high protein diet.[2] Nelson[3] has shown that the addition of a high protein supplement to the diet of football players had no effect on their ability to perform selected gross motor tests.

However, Yamaji[4] reported reduction in the total amount of hemoglobin and serum protein during heavy muscular work in which the protein intake remained at 1 to 1.5 gm. per kg. per day. Nagamine[5] found that muscular exercise does not accelerate protein metabolism, but recommended a range of 1.5 to 2.0 gm. per kg. per day during exercise periods. Since these figures exceed the United States Recommended Dietary Allowance of 1 gm. of protein per kg. per day[6] further controlled investigations appear indicated.

The various research projects cited in the literature deal largely with laboratory subjects, miners and other manual workers; not with men primarily interested in achieving increased strength and muscular development. It is possible that their findings are not applicable to the latter, since authorities on nutrition[7,8] readily concede that to be meaningful, studies of the value of supplementing an individual's diet must be made under the conditions of his work program. It was the purpose of this study to determine whether a given protein supplement contributes to the achievement of strength and muscular mass when taken in conjunction with a program of progressive resistance exercise.

DESIGN AND METHOD

Thirty healthy adult male third and fourth year students at the California College of Medicine served as subjects. Their weights were recorded and the isometric strength of the elbow flexors and elbow extensors were measured by use of a Baldwin-Lima SR-4 load cell. The girth of the upper arm was measured with a steel tape. The arm was marked at approximately the insertion of the deltoid, and the volume was measured by immersing the limb in a water plethysmograph to this mark. The level at which the measurement was taken was marked on the arm, and the indicator was renewed as often as necessary during the training period, so that the measurement could be replicated.

The subjects were divided into two groups of fifteen each, equated on the basis of the total of the four initial isometric strength scores. Results of the F test for homogeneity of variance (F = 1.09 and 0.07) indicated that these two groups were from a homogeneous population in regard to strength. Three training sessions (one week) were devoted to teaching the technic and determining the amount each man could handle in fairly strict style in the following exercises with a barbell: two hands press, two hands curl, supine bench press, two hands re-

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TABLE I
Mean Changes Resulting from Training

Data	No.*	Before Training	After Training	Difference	Significance
Body weight (in lb.)					
Protein supplement	13	163	165	2	N.S.
Placebo	14	167	171	4	N.S.
Differences between groups		4	6	2	N.S.
Total weights lifted (in lb.)					
Protein supplement	13	308.4	418.2	109.8	Sig.
Placebo	14	286.6	412.4	125.8	Sig.
Differences between groups		21.8	5.8	16.0	N.S.
Right arm volume (in cc.)					
Protein supplement	12	284.90	304.70	19.8	N.S.
Placebo	13	276.78	296.58	19.8	N.S.
Differences between groups		8.12	8.12	0.0	N.S.
Left arm volume (in cc.)					
Protein supplement	12	277.56	291.78	14.22	N.S.
Placebo	13	271.54	289.89	18.35	N.S.
Differences between groups		6.02	1.89	4.13	N.S.
Right upper arm girth (in cm.)					
Protein supplement	13	33.50	34.70	1.20	N.S.
Placebo	14	33.58	35.04	1.46	N.S.
Differences between groups		0.08	0.34	0.26	N.S.
Left upper arm girth (in cm.)					
Protein supplement	13	32.58	33.95	1.37	N.S.
Placebo	14	33.07	34.56	1.49	N.S.
Differences between groups		0.49	0.61	0.12	N.S.

* Three of the subjects did not complete the training program and in two cases the marks for the measurement of arm volume disappeared.

verse curl. The subjects then exercised three days a week for six weeks. At every training session three sets of five repetitions of each of the foregoing exercises were performed. Two minutes rest was taken between each set, in accordance with the findings of Clarke, Shay and Mathews.[9] During the training period the subjects increased the weight whenever they felt more could be handled, but the number of repetitions remained the same. This is not the usual system employed in gymnasia, but in view of Barney and Bangerter's[10] demonstration that neither the standard strength program nor the standard hypertrophy program developed statistically significant increases in hypertrophy after eight weeks of training, it appeared judicious to try a different approach.

During the six weeks of exercise the experimental group received ten tablets a day of protein dietary supplement. The manufacturer states that this is probably of more nutritional value than a half quart of milk, and adds about 2.5 gr. of protein and approximately 30 calories to the diet. The control group ingested a similar number of tablets per day of a placebo furnished by the manufacturer of the protein supplement and consisting principally of lactose, kaolin and cornstarch. The investigation was conducted on a double-blind basis and neither the subjects nor the experimenters were aware of which product was being received by any given individual.

At the end of the training period all measurements were repeated, and the statistical analysis was completed before the experimental and control groups were identified to the investigators. The changes in arm volume and upper arm girth were subjected to an analysis of variance; body weights and amounts of weights used in training were given a t test. No statistic was considered significant unless the chance occurrence of such a statistic was 1 per cent or less.

RESULTS

The results are set forth in Table I. It will be observed that neither training program produced significant changes in body weight ($t = 0.28$ and 0.40 for those receiving the protein supplement and the placebo, respectively), in arm volume for either arm ($F = 0.96$ with 7 and 92 df), or in upper arm girth ($F = 0.14$ with 7 and 100 df) for either arm. The amount of weight handled in the four exercises showed a significant increase for

both groups (t = 4.56 for those receiving the protein supplement and 5.81 for those receiving the placebo); there was no significant difference between the two groups.

It appears that the addition of protein supplements to the food intake of male college students presumably subsisting on a normal American diet does not increase the amount of body weight, muscular hypertrophy or strength resulting from training with progressive resistance exercises at the level utilized in this study.

COMMENTS

Certain problems are inherent in evaluating the results of investigations of this kind. Limitations of the F and t tests in anthropometrical measurements have been a matter of concern to anthropologists.[11,12] Tanner[13] has suggested that the role played by the individual's physique, his environmental circumstances and his motivation are such that it is not satisfactory to discuss in general terms the results of such training experiments as the present study. In his opinion, tests of the significance of the mean gain and tests of the individual's gain evaluate two fundamentally different hypotheses. In the present study the *direction* of the changes in girth of the upper arms was positive in every case. For a group of this size and variance to have achieved a statistically significant gain a mean increase of 2.1 cm. (0.82 inch) would have been required; only two individuals (both in the protein supplement group) actually achieved this figure. After four months of training at a commercial gymnasium each of Tanner's subjects made a statistically significant increase in the circumference of the upper arm. His reported data are not complete, but the average change given for eight subjects falls between 2.1 and 2.2 cm., which is consistent with the present findings. The results of numerous studies in this field indicate that in many cases six to eight weeks is not a sufficiently long period to produce statistically significant gains in muscular hypertrophy. This suggests that future experiments involving diet and progressive resistance exercise should be planned to cover a longer period of time.

SUMMARY

Thirty male medical college students were placed on a program of progressive resistance exercise. Half of the subjects were given a commercial protein dietary supplement, the other half a placebo. At the end of six weeks of training there were no significant differences between the two groups insofar as changes in body weight, arm volume, upper arm girth or strength were concerned.

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