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Protein Quality of Noodles Supplemented with Fish Protein Concentrate

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=國文抄錄=

濃縮 生鮮蛋白質로 補充된 국수의 蛋白質의 質에 對한 硏究

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농축생선단백질(Fish Protein Concentrate, FPC)로 보충된 국수의 영양가를 연구하기 위하여 25일된 쥐를 사용하여 4주 동안 동물 실험을 하였다. 각각 10마리씩 네 group으로 나누어 0, 10, 15% FPC와 표준 casein diets를 주고 매일 섭취량을 기록하고, 매주 동물의 체중을 재서 Protein Efficiency Ratio (PER)를 계산함으로써 단백질의 質을 평가하였다. 4주 후에 동물의 간을 취하여 수분과 지방의 양을 측정하였다. 또한 농축생선 단백질로 보충된 국수가 음식으로서의 적응도를 측정하기 위하여 어른 10명과 아이들 5명에게 관능 검사를 실시하였다.

FPC 15% diet group의 체중은 4주 동안에 157.2g이 증가했고, FPC 10%는 135.7g, casein은 103.0g, FPC 0%(plain noodle)은 25.8g 밖에 되지 않았다. 이것들의 PER은 FPC 15% diet group이 3.83으로 제일 높았고, 다음이 FPC 10%로 3.35였고, casein은 이보다 낮은 3.31이였다. 간의 지방양은 FPC 15% diet group이 2.94%로 제일 낮았으며, FPC 10%가 3.98%, casein이 5.57%의 순서였다. 지방의 양이 적을수록 단백질의 質이 높다는 것을 말하며, 5% 정도가 보통이다. PER, 동물의 체중과 지방의 양으로 단백질의 質을 측정한 결과 FPC 15% 국수가 質이 제일 좋다는 것이 판명되었다.

관능검사 결과 전체적 계수는 FPC 15% 국수가 제일 낮은 2.7 (1.0에서 5.0까지 사용)이고 다음이 FPC 10% 국수로 3.5였으나 plain noodle만 못하였다. 특히 색갈(color)에 많은 차이를 보였기 때문이며, 맛(flavor)과 질(texture)에는 별 차이가 없었다. FPC 15% 국수는 색갈이 plain noodle에 비해 검은 편이였으나 모밀국수 보다는 색갈이 희므로 그렇게 문제가 될것 같지는 않다. 어린 아이들에게는 닭 국물에 국수를 넣어 주었더니 라면과 맛이 비슷해 아주 좋아했다.

INTRODUCTION

Protein is probably the most critical nutrient in the world today. About one half of the world population does not get enough high quality protein (Abbott, 1966)[1]. The diets of these people consist mainly of cereal grains which do not furnish sufficient high-quality protein. This is especially serious in infants and young children since it adversely affects their survival, growth, and mental development.

Man cannot survive on a cereal grain diet because all cereal grains are relatively low in protein of low quality. They are particularly deficient in lysine. Lysine is one of the essential amino acids and it can be supplied by

the consumption of an animal protein or a balanced vegetable protein. But a large segment of the world population cannot afford to buy these nutritious but expensive products.

One solution to the problem would be to find a way to supplement cereals with an inexpensive high-quality protein. Levin (1964)[2] stated that fish protein concentrate (FPC) meets these requirements. While lysine is essential in cereal fortification, fish is low in methionine. Thus, cereals rich in methionine and low in lysine supplement FPC which is low in methionine and rich in lysine.

The Food and Agricul ture Organization[3] has drawn attention to edible fish flours containing up to 75~80% protein of high quality, as well as calcium and vitamin B-12. A low-priced purified fish flour has great advantages in that it can be stored at ambient temperatures without loss of nutritional value. Furthermore, it can be incorporated in a wide variety of food products (van Mameren and Bon, 1969)[4].

FPC is a light brown, slightly gritty powder. It is prepared by grainding whole fish and extracting the fat from the powder. The resulting almost odorless, tasteless, and stable flour contains close to 85% protein. FPC is an excellent source of a high-quality protein because it contains a favorable balance of all essential amino acids, plus minerals in their original and practically unmodified forms (Brody, 1965)[5]. FPC is very inexpensive compared to other animal proteins. The price of protein in FPC is about one fifth that of beef (Abbott, 1966)[1]. FPC is valued very highly by many workers,[6,7] but there has been limited investigation of its use in food products.

The use of FPC for human consumption is a relatively new concept to combat protein malnutrition. The addition of a small quantity, 5~10% of FPC, to staple foods which are low in protein can increase their protein value considerably. Autret and van Veen (1955)[8] added 10% FPC to bread fed to school children in Chile. Even though the color was darker than that of regular bread, it was readily accepted. Gomez et al. (1958)[9] in Mexico and Somer et al. (1958)[10] in El Salvador tested FPC and found drastic improvements in nitrogen retention and rate of height and weight gains in preschool children with various degrees of malnutrition. In all cases, the FPC-enriched dishes were readily accepted. Daily supplementation of the diet with 30 g or fish flour was of significant value in the treatment of children suffering from kwashiorkor and marasmus in accelerating the rate of their recovery. Pretorius and Wehmeyer(1964)[11] assessed the nutritive value of fish flours versus dried skim milk at 10% levels in the diet in the treatment of 45 convalescent kwashiokor patients and concluded that there was no difference in rate of recovery. Jezorek and McCreary (1968)[12] studied the effect of the addition of FPC in biscuits. They found that up to 7% FPC gave an acceptable product as judged by a taste panel. Kwee et al. (1969)[13] added 10 and 20% FPC to flours of rice, corn, soya, and tapioca. From sensory evaluations, rice pasta appeared to be the most acceptable.

The purpose of this study was to investigate the possibility of making an acceptable product with FPC as a major source of protein for chlidren in developing countries, to determine whether differences in protein quality exist between different levels of FPC in noodles and standard casein, and to estimate the protein quality by protein effeciency ratio of growing rats.

EXPERIMENTAL

Evaluation of protein quality

Protein quality was determined by protein efficiency ratio (PER). The standard procedure by Derse (1960)[14] and Campbell (1963)[15] was used. For each diet a group of 10 weanling male rats of a single strain (25 days old, obtained from Charles River Breeding Lab. Wilmington, Mass.) was placed in individual screen-bottom cages. The weights of the animals extended over a range of 20 g and the animals were divided into groups so that the average weight of each group was approximately the same. The animals were supplied with water and test ration ad libitum and kept in a room at 21 −24°C. The animals were weighted at weekly intervals. Daily food consumption data were also collected. The experiment lasted for four weeks. At the end of the four-week feeding period, the average weight gain per average protein consumption was calculated for each group. Fat content and moisture content of the rats livers were determined (AOAC, 1965)[16].

Preparation of Test Diets

Noodles were prepared from all-purpose flour and water with FPC (VioBin FPC) added in proportions 0, 10, and 15% of the weight of the flour. In addition to the test groups, a reference standard group of rats on a diet of the basal ration with casein at the level of 10% protein was included. Protein level in the finished, cooked noodles was determined (Table 1). The diets were mixed with corn starch, corn oil, salt mixture, and vitamin mixture to contain approximately the same amount of calories. The total protein content of the diets containing casein or FPC-enriched noodles was approximately 10%. Nitrogen content of diets were determined by macro-Kjeldahl method using boric acid (Blaedel and Meloche, 1957)[17].

Table 1. Protein content of cooked noodles

Ingredients	Protein content (%)
plain noodle	10.4
10% FPC noodle	17.5
15% FPC noodle	19.9

Evaluation of product acceptability

The noodles were evaluated by a taste panel composed of 5 children and 10 adults. The noodles were cooked in boiling water, drained, cooled, and presented to a taste panel of 10 adults. The panel tasted 3 different types of noodles and scored them by flavor, texture, color, and over-all acceptability. Ten percent and 15% FPC supplemented noodles were cooked in a soup separately and given to the children for their lunches at different times.

RESULTS AND DISCUSSION

Effect of test diets on rat growth and PER

Weight gains and food intakes of the experimental rats for the four-week period as well as the PER of the proteins are shown in Table 2. Weight gain was essentially normal, with the exception of rats on plain noodles. The total amount of food intake was the greatest for rats on 15% FPC noodles, and the least for rats on plain noodles. An analysis of variance showed that weight gains between different diet groups are significant at the 0.01 level. There was significant difference in weight gains between the rats on casein and 10% FPC, and on 10% FPC and 15% FPC.

Table 2. Effect of diets on weight gain and PER values

Diet	No. of rats	Average total weight gain (g)	Average total food intake (g)	PER
plain noodle	10	25.8	15.37	1.61
10% FPC noodle	10	135.7	40.37	3.35
15% FPC noodle	10	157.2	40.86	3.83
casein	10	103.0	32.04	3.21

Table 3. Moisture and fat content of livers

Diet	Average size fresh wt. (g)	% of body weight	Moisture content (%)	Fat content (%)
plain noodle	3.9	4.62	74.65	3.91
10% FPC noodle	9.7	4.98	73.76	3.98
15% FPC noodle	10.6	4.90	73.79	2.94
casein	8.4	5.18	74.63	5.57

The PER (Table 2) for the standard reference casein was 3.21. This is lower than the 10% (3.35) and 15% (3.83) FPC supplemented diets. There was significant difference between groups at the 0.01 level. There was no significant difference between casein and 10% FPC supplementation. The difference between casein and 15% FPC, 10% FPC and 15% FPC, and casein and plain noodles were significant at 0.001 level. Similar increases in the PER of FPC-supplemented cereal diets were observed by Sure (1957),[18] Metta(1960),[19] Jaffe(1961),[20] Moorjani(1968),[21] and Sidwell et al. (1970).[22]

Liver composition

Table 3 shows the result of the liver analyses for moisture and fat content. All the livers were normal in color but the livers of the rats on the plain noodles were somewhat smaller compared to the other rats. The moisture contents were similar for all groups and were comparable to normal percentages. The fat contents varied between groups. Rats on casein had the highest percentages and the rats on 15% FPC the lowest. Low fat content in the liver of rat indicates that the protein quality of the diet is good. It seems that 15% FPC-supplemented noodles are the highest quality protein among other diets. Methionine needs of rats are high but in casein diet, 10% casein probably does not give enough methyl groups for the utilization of fat. And thus gives a high fat content in the liver.

Evaluation of product acceptability

A taste panel of 10 adults (7 Americans and 3 Koreans) were asked to evaluate three different levels of FPC supplemented cooked noodles. The results are given in Table 4.

There was no significant difference in the scores for the plain and 10% FPC noodles for over-all acceptability but significant differences in flavor, color, and texture. The taste panel scored the cooked noodles with 10% FPC significantly higher in overall acceptability than those with 15% FPC. The former were rated almost as high as plain noodles. In general, Americans scored lower in all quality factors than Koreans, especially in color of

Table 4. Average scoresof FPC supplemented noodles

% FPC	Flavor	Color	Texture	Over-all acceptability
0	4.1	4.6	4.1	4.0
10	3.5	3.0	3.6	3.5
15	3.2	2.8	3.5	2.7

1 to 5 scales were used.

FPC supplemented noodles. But the color of the noodles will not affect the acceptability to Orientals because some commonly used noodles are even darker in color. Only 3 judge could detect a fishy flavor in 15% FPC noodles and 2 judges said that 10 and 15% FPC supplemented noodles had a coarse texture. Five Korean children tasted 10 and 15% FPC noodles cooked in a chicken broth soup. They taste very similar to the instant noodles (Ramen) which the children and adults like to eat in Korea, China and Japan. The children liked the noodles very much.

CONCLUSIONS

It is concluded that both the 10% and the 15% FPC supplemented noodles are acceptable as protein sources in the diet of Orientals, especially children. The quantities of these noodles usually eaten are sufficient to make a major contribution at the protein supply of those individuals.

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