NUTRITIONAL PROPERTIES OF SESAME FLOUR PREPARED FROM INDIGENOUS SESAME SEED CAKE

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Sesame flour was prepared from sesame seed cake locally available. Protein content and net protein utilization value (NPU_{st}) of the flour were 42.5% and 44.6%, respectively. NPU of the flour was improved by supplementation. Two blends:(1) containing sesame flour, Bengal gram flour and fish protein concentrate (NPU_{st} 86.3), and(2) containing sesame flour, Bengal gram flour and skim milk powder (NPU_{st} 78.5) were prepared. These were found excellent supplements to indigenous cereals.

Introduction

Sesame seed cake as a source of protein for human consumption has been studied by several investigators.[1,2] While determining the feeding value of various protein foods on a group of African children it was observed that the proteins of soya, groundnut, cottonseed and sesame seed flour have a reasonably good nutritive value and these can be used as supplementary sources of protein.[3] Joseph *et al.*[4] have also reported good supplementary value of sesame flour-based foods to a maize-tapioca diet.

Pakistan produces about 37,000 tons sesame seeds annually.[5] After expression of the oil, the oil cake left is mainly used as a cattle feed. If a part of the total product is converted into edible flour for human consumption, it can greatly help to supplement our meagre protein sources for feeding vulnerable groups of the population.

In a preliminary study it was noted that net protein utilization standardized (NPU_{st}) value of indigenous sesame flour was 44.4 and so it cannot be recommended as a sole source of protein in human diets. Beneficial effects of lysine supplementation on the biological value of sesame meal are reported in the literature,[6] but since supplementation with synthetic lysine is not practically feasible at the moment due to its non-availability in the country, it was considered desirable to improve the protein value of sesame flour by admixture with cheap protein sources available in Pakistan and to study the supplementary value of the suitable blends to common indigenous cereals.

Experimental

Net Protein Utilization of Sesame Flour and their Different Blends.—Sesame seed cake was obtained locally. It was ground in a ball mill and sieved through a 60 mesh sieve. Fish Protein Concentrate (FPC) was made from sundried salted fish according to procedure described elsewhere.[7] Bengal gram flour (*Cicer arietenum*) was purchased locally. Skim milk powder was supplied through the courtesy of Director Health Service, Lahore. The protein concentrates chosen for the present study are shown in Table 1. The protein content was determined by a semimicro Kjeldahl method.[8]

The protein concentrates were incorporated in a semisynthetic diet by replacement of maize starch in such a manner that the protein content was ca. 10%. The composition of various diets is shown in Table 2. All the ingredients required for the various diets were thoroughly mixed in an electric food mixer.

NPU, calories, and protein calories % of the diets were determined according to the method described earlier.[9] NPU standardised were calculated from NPU figures by the formula of Miller and Payne.[10] The results of NPU determination are shown in Table 3.

Net Dietary Protein Value of Certain Indigenous Cereals Containing Blend No. 5 at Various Levels.—Blend No. 5 was added to wheat, rice, maize, pearl millet (*Pennisetum glancum*) at 5, 10 and 15% level and their NPU operative and net dietary protein calories % (NDp cals%) were determined as previously.[9] The results are shown in Table 4.

Net Dietary Protein Value of Certain Indigenous Cereals Containing Blend No. 7 at Various Levels.—Blend No. 7 was added to wheat, rice, maize and millet at 5, 10 and 15% level and their NPU op and NDp cals% were determined as previously.[9] The results are shown in Table 5.

Discussion

From an examination of the data presented in Table 3 it will be observed that the NPU of sesame

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flour prepared from indigenous cake is 42.5 which is somewhat low as compared to the figure of 56 reported in the literature.[12] This may be due to difference in variety or heat damage during the course of expression of oil. Thus in its present form it cannot be recommended for direct human consumption. An ideal protein food for feeding vulnerable groups of the population should possess protein value (BV or NPU) comparable to that of animal protein and should also be acceptable to the consumers. With these objects in view we attempted to improve the protein value of sesame flour by supplementation. It was found that NPU_{st} of sesame flour increased significantly ($P < .01$) from 42.5 to 56.0 by supplementing with equal weight of Bengal gram flour (Table 3). It further increased significantly ($P < .01$) to 86.3 and 92.8 when the mixture of sesame and Bengal gram flour was supplemented with 25% and 50% FPC, respectively (Blends 5 and 6).

Since Blend 5 requires half the quantity of FPC as compared to Blend 6 with very little increase in NPU, the former seems to be more suitable from the point of view of cost and taste. This blend was therefore tried for determining its supplementary value to common indigenous cereals.

Table 4 shows an improvement in the NPU op and NDp cals% of the cereals by stepwise addition of Blend 5. Diets yielding NDp cals values above 8 are considered suitable for feeding young children[13] and this is achieved by adding even 5% of the blend to wheat and millet. Rice and maize require the addition of 10% or more of the blend to achieve NDp cals values higher than 8.0 because of their initial low protein content.

The advantage of this type of admixture lies in the fact that quantity of FPC can be reduced without appreciable decrease in the protein nutritive value of the mixture. Thus if Blend 5 is added to the extent of 15% in wheat flour the contribution of FPC will be only 2%. At this level the taste and smell of FPC is hardly perceptible to an average consumer.

Similar results were obtained by supplementation studies with skim milk powder (Table 5). Although the NPU_{st} of Blend 8 was slightly higher (85.8) than that of Blend 8 (78.5), Blend No. 7 is still preferred since it contains half the quantity of skim milk powder than that contained in Blend 8 which would make the former cheaper to produce. It will be observed that Blend 7 should be added to the extent of 10% to wheat and millet and 15% to rice and maize to yield NDp cals% of 8 or more. This Blend is slightly inferior to that containing FPC (Blend 5), but when used as such for feeding, it is more palatable than Blend 5.

TABLE 1.—PROTEIN CONCENTRATES AND THEIR VARIOUS BLENDS USED IN THE EXPERIMENTAL DIETS.

Blend	Protein concentrates		Protein (N %×6.25)
1	Sesame flour		42.5
2	Fish protein concentrate		79.0
3	Skim milk powder		35.9
4	Sesame flour	50%	31.6
	Bengal gram flour	50%	
5	Sesame flour	37.5%	
	Bengal gram flour	37.5%	43.5
	Fish protein concentrate	25%	
6	Sesame flour	25%	
	Bengal gram flour	25%	55.3
	Fish Protein Concentrate	50%	
7	Sesame flour	37.5%	
	Bengal gram flour	37.5%	32.7
	Skim milk powder	25%	
8	Sesame flour	25%	
	Bengal gram flour	25%	33.6
	Skim milk powder	50%	

TABLE 2.—PERCENTAGE COMPOSITION OF THE EXPERIMENTAL DIETS CONTAINING VARIOUS PROTEIN CONCENTRATES*.

Diet No.	Protein concentrates g	Maize starch g
1	23.5	26.5
2	12.7	37.3
3	27.8	22.2
4	31.6	18.4
5	23.0	27.0
6	18.0	32.0
7	33.6	66.3
8	29.8	70.2

*The diets also contained the following other ingredients: Fat 15 g; glucose 15 g; potato starch 10 g; vitamin mixture[11] 5 g; mineral mixture[11] 5. g.

TABLE 3.—NET PROTEIN UTILIZATION OF THE EXPERIMENTAL DIETS.

Diet No.	Protein %	kcal/g	Protein cals%	NPU % at 10% protein level	NPU_{st} %
1	10.4	4.11	10.1	42.6	44.4
2	10.0	4.00	10.0	86.9	98.7
3	10.2	4.08	10.0	75.5	84.7
4	10.5	4.15	10.1	53.6	56.0
5	10.3	4.11	10.0	76.8	86.3
6	9.9	3.96	10.0	82.2	92.8
7	10.6	4.15	10.2	63.7	78.5
8	9.9	3.90	10.2	69.6	85.8

Table 4.—Supplementary Value of a Blend of Sesame Flour, Bengal Gram Flour and FPC to Some Indigenous Cereals.

Diets	Protein %	kcal/g	Protein cal %	NPU* op %	NDp cals %
Wheat	11.0	3.51	12.5	50.3	6.3
,, + 5% protein concentrate ..	12.6	3.62	13.9	63.0	8.8
,, + 10% ,,	14.2	3.64	15.6	72.9	11.4
,, + 15% ,, ...	15.8	3.65	17.3	73.1	12.6
Rice	7.5	3.35	8.8	54.2	4.9
,, + 5%	9.3	3.37	10.0	59.1	6.0
,, + 10% ,, ...	11.0	3.39	13.0	65.5	8.5
,, + 15%	12.8	3.41	12.1	67.8	10.2
Maize	8.8	3.44	10.2	53.4	5.5
,, + 5%	10.5	3.46	12.2	54.9	6.7
,, + 10%	12.2	3.47	14.2	60.8	8.6
+ 15%	13.9	3.49	15.9	63.2	10.1
Millet (*Pennisetum typhoides*)	11.8	3.40	13.9	49.4	6.9
,, + 5% ,, ...	13.4	3.42	15.6	56.6	8.8
,, + 10% ,, ...	14.9	3.44	17.3	58.4	10.1
,, + 15% ,, ...	16.5	3.46	19.0	64.3	12.2

*Mean values of 8 rats per group.

Table 5.—Supplementary Value of a Blend of Sesame Flour, Bengal Gram Flour and Skim Milk Powder to Some Indigenous Cereals.

Diets	Protein %	kcal/g	Protein cal %	NPU* op %	NDp cals %
Wheat	11.0	3.50	12.5	50.3	6.3
,, + 5% Protein concentrate ..	12.1	3.52	13.6	56.0	7.6
,, + 10% ,, ...	13.1	3.53	14.8	64.9	9.2
,, + 15% ,, ...	14.2	3.55	15.8	70.2	12.1
Rice	7.5	3.35	8.8	54.2	4.9
,, + 5% ,, ...	8.7	3.37	10.3	56.1	5.8
,, + 10% ,, ...	9.9	3.40	11.6	60.5	7.0
,, + 15%	11.1	3.42	12.9	64.8	8.4
Maize	8.8	3.44	10.4	53.4	5.5
,, + 5% ,, ...	9.9	3.46	11.6	54.0	6.3
,, + 10% ,, ...	11.0	3.48	12.4	58.3	7.2
,, + 15% ,, ...	12.3	3.49	14.0	62.0	8.7
Millet	11.8	3.40	13.9	49.4	6.9
,, + 5% ,, ...	12.8	3.41	15.0	53.6	8.0
,, + 10% ,, ...	13.7	3.44	16.0	56.3	9.0
,, + 15% ,, ...	14.7	3.46	17.1	60.5	10.3

*Mean values of 8 rats per group.

The sesame flour prepared from indigenous cake can be used in human feeding after proper supplementation. However, the present method of its production and storage in Pakistan are very unsatisfactory. Before introducing it for direct human consumption it is necessary that the flour should be produced under hygienic conditions with minimum exposure to dust and dirt and and that it should contain the least amount of hull.

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