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PREPARATION AND NUTRITIONAL EVALUATION OF A DOMESTIC LEVEL VEGETABLE PROTEIN MIXTURE AND SOME COMMON MEALS BASED ON IT

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A study was made of a previously formulated domestic level vegetable protein mixture using it in three traditional Pakistani dishes: (1) Chappati-curry, (2) Dahi baray, and (3) Khichri. Through preference tests acceptable products were produced. The cooked dishes were then assayed for protein nutritional value. It was observed that the basic mixture and the diets Nos.1–3. Yielded the following values respectively:

N.P.U. op% = 50.0, 60.1, 57.9, 56.5
N.P.U. st% = 73.8, 77.1, 80.8, 82.2
(protein score)
NDp cals% = 10.0, 9.6, 10.9, 11.4

The NDp cals% were higher than the minimum value laid down for feeding infants. Other vulnerable groups of the population could also be benefitted by using it as a supplementary food. Possibilities for commercial production have also been indicated.

INTRODUCTION

Malnutrition is a serious public health problem in developing countries. Several reports [1–3] have also indicated the deficiency of Pakistani diets with respect to calories, high quality protein and other nutrients. Although several causes have been identified but feeding of inadequate and ill-balanced diets is the major one. With a view to correcting the poverty of diets, a large number of formulated protein foods (multipurpose food, Supramine, 'Bal Ahar' corn-soya-milk, wheat-soya blend) and protein supplements [4, 5] (fish protein concentrate, oil seed protein concentrates) have been developed during the past two decades for feeding malnourished infants and children and other vulnerable groups of the population, particularly belonging to low income groups, who cannot afford expensive protein-rich foods such as milk, meats and eggs.

However, most of the foods are processed and ready-to-serve and, therefore, require big capital investment for their economical production. In humid tropics they require good packaging material for a reasonable shelf-life. It is estimated that the cost of processed foods is two to four times the cost of the raw material [5]. Another defect is that, in order to maintain a good keeping quality, either the fat is completely excluded or very little is added so that the energy content of the food sometimes is too low. The capacity of an infant's stomach is limited (ca. 200 ml). If the food is not taken in sufficient quantity, the baby can still remain physiologically hungry though the bulk of the food can provide him a feeling of 'belly-fulness. It can be harmful as the energy and protein needs per unit body weight of a rapidly growing child are much higher as compared with other groups of the population. To increase the energy content of the food the strach contained therein is dextrinised (e.g. Superamine (Egypt) and Shadamin (Iran) prior to roller-drying, thus increasing the solubility of the food [6]. Recently developed technique of extrusion cooking also assists in partial hydrolysis of polysaccharides [7]. Both the techniques involve a big layout and heavy capital expenditure.

Due to poor performance of most of the processed weaning/protein-rich foods in commercial markets, Jelliffe [4] and Cameron and Hofvander [8] have advocated the feeding of domestic or village level infant foods from the raw materials locally available. Jelliffe [4] has coined the terms–double (e.g. cereal–pulse), triple (e.g. cereal–pulse–vegetable), quadri (e.g. cereal–pulse–meat–vegetable), and multi (e.g. cereal–pulse–meat–vegetable–fat) mixes for

such mixtures. It is better if we pay our attention towards improving an existing traditional food rather than formulating a totally new food which does not fit into our traditional dietary pattern and therefore presents difficulties in consumer acceptability. The vegetable protein mixture is an improved version of khichri (a triple-mix containing rice, mung beans and fat) a commonly used weaning food of the Indo-Pakistan subcontinent. The present paper, deals with the preparation and nutritional evaluation of the protein mixture and three common meals based on it.

EXPERIMENTAL

Preparation and Organoleptic Evaluation of the Diets. For the preparation of basic mixture the formula developed by Shakeel [9] was employed. The pulses, peanuts and sesame seeds, purchased from the local market, were dehulled and deskinned. Broken rice was cleaned of dust and dirt by sifting through a 60-mesh sieve. Pulses were cooked and dried at 60° to inactivate antinutritional factors [10] before grinding into flour. The percentage composition of the various ingredients used in the mixture [9] was as follows.

Name			
English	Pakistani	Botanical	Wt. (g)
Green gram	Dal mung	*Phaseolus mungo*	30
Bengal gram or chick pea	Dal chana	*Cicer arietinum*	24
Peanut	Moongphali	*Arachis hypogea*	18
Sesame seed	Til	*Sesemum indicum*	9.5
Rice	Chawal	*Rhiza sativa*	18.5

For the purpose of preference tests a complete meal (curry-chappati), a snack dish (dahi baray - small doughnuts made of chick pea flour and spices and immersed in curd) and a traditional weaning food (khichri) were selected. The standardized recipes are shown in the Appendix.

Organoleptic Evaluation. A taste panel consisting of 8 judges was selected from the staff of the College of Home Economics, Lahore (4 from teachers and 4 from Lab. assistants) and trained to carry out preference tests. The panel was presented with two variations of the chosen dishes at each sitting. Panel members were given a score card (this card is being used for product evaluation at PCSIR Laboratories, Lahore) numbered from 0–10 on a hedonic scale (0 - not acceptable; 10 excellent) and were asked to evaluate the product on the basis of appearance, texture, taste and flavour (Table 1).

Biological Evaluation.

Diets. Besides, the basic mixture, the preferred dishes of 'dahi baray' and 'khichri' were prepared in four times the quantity given in the recipes. For curry-chappati combination an average number of chappaties i.e. three, taken by an adult with one plate of curry, were combined together in the proportion of 114 g curry (wt. of one plate of curry) to 165 g of wheat flour (55 g wheat flour make one chappati).

All the three dishes were dried in air circulating oven at 55–60°. These were spread thinly on trays and as soon as excess moisture was removed, the diets were ground, weighed and stored in separate tins for animal assays (originally it was planned to dry the diets in freeze-drier but as it was out of order to diets were dried in an air-circulating oven).

Protein Calories % Total Calories (P cals%). Nitrogen (N) content of the diets was determined by Kjeldhal method followed by microdistillation by the method of markham [11]. Calories were determined by means of a ballistic bomb calorimeter according to the method of Miller and Payne [12]. P cals% were calculated by the formula:

$$\text{P cals\%} = \frac{6.25\,\text{N} \times 4}{\text{Cals/g}}$$

Net Protein Utilization Operative (N.P.U. op). N.P.U. op. was determined according to the method of Miller and Bender [13]. The weights of albino rats weaned at 21 days of age ranged between 22–30 g. They were arranged in groups of 4 rats each so that the weight of each group varied within ± 1 g. They were put on a stock diet for two days before feeding them on the experimental diets. Food and water were given *ad libitum.* After the experimental period of 10 days the rats were killed by chloroform and the carcasses were dried to constant weight at 105° for 48 hr.

N.P.U. (op) was calculated from the following equation.

$$\text{N.P.U. op} = \frac{B-(B_k-I_k)}{I}$$

where B and B_k are the total body N of the animal on the test and nonprotein diets respectively, and I and I_k are the intake of N in the two groups (for details of the method, composition of nonprotein diet, etc. the original report should be consulted [13].

Table 1. Organoleptic evaluation of various dishes (mean scores of 8 judges are given).

Dish	Appearance	Flavour	Texture	Taste	Total
Curry, variation A	7.3	5.8	7.8	6.9	27.8
" B	6.3	5.5	7.3	5.0	24.1
Dahi baray, variation A	4.8	5.8	5.5	5.5	21.6
" B	6.0	6.8	6.0	6.5	25.3
Khichri, variation A	5.8	4.5	5.8	6.0	22.1
" B	6.5	7.0	4.5	7.5	25.5

N.P.U. Standard (N.P.U. st). N.P.U st, which is equivalent to protien score [14] was calculated according to the equation:

$$\text{N.P.U st} = \frac{\text{N.P.U op} \times 54}{54-P} - 8^{15}$$

NDp cals% of the diets were calculated by multiplying P cals% by N.P.U. op [14].

RESULTS AND DISCUSSION

Curry. From an examination of Table 1, it will be observed that variation A of vegetable mixture-curry constantly scored higher than variation B. The difference was in the method of preparation. For example, in dish A, sesame seed, were browned in ghee for 2½ min until golden brown, then the rest of the ingredients were added. This method produced a good flavour, a better texture and good colour.

While dish B, in which the sesame seeds were added with the rest of the ingredients, appeared to have a raw flavour. The dish was not very acceptable to the panel members.

Dhai Baray. In the case of dahi baray both the variations contained the same amounts of ingredients except the amount of baking powder and some difference in the method of preparation.

Dish 'A' contained 1½ tsp baking powder and the batter was made only 3 hr before frying, while dish 'B' contained 2½ tsp baking powder and the batter was kept for nearly 10 hr which made baray soft and more porous.

Dish A was hard and compact, therefore, it was not very good. It was also more brownish than dish B. Dish 'B' baray were more acceptable to the panel members for their soft texture, good flavour and desirable colour.

Khichri. Although both the dishes (A and B) contained equal amounts of ingredients but they scored differently due to difference in the method of preparation. Dish A contained coarsely ground grains (ground in mortar and pestle) which gave it a slightly acceptable texture, while in dish B all the ingredients were used as natural whole grains and the dish had a very palatable flavour and colour. It was liked more than dish A by the panel members although the texture was not good.

Another difference was that when the sesame seeds were added at the end, they had a 'raw' taste as in dish 'A'. But when they were browned in ghee before the addition of other ingredients such as rice and dals (gram and moong), a good flavour was obtained and there was no 'raw' taste.

Biological Evaluation

The results of N.P.U. determination (Table 2) show that the vegetable protein mixture and all the three dishes are rich in protein with respect to quantity and quality. N.P.U. op. ranges between 56.5–60.1, N.P.U. st. between 73.8–82.2 and NDP cals% between 9.6–11.4. Thus the N.P.U. st or chemical score is almost equal to that of casein and NDP cals% is more than 8 which is the value yielded by cow's milk [16]. According to F.A.O. [16], a food combination of NDP cals% equal to 8 or more is suitable for feeding infants whose energy and protein requirements are the highest of all the other groups of the population.

If desired it can be produced commercially both by roller drying and extrusion cooking and can serve as a ready-to-serve protein food for feeding infants and other vulnerable groups of the population, i.e. expectant and nursing mothers, invalids and convalescents. Attempts will now be made to test the food by feeding malnourished children in the form of a soft 'khichri'.

Other special featurs are (1) due to incorporation of legumes it is rich in lysine in which cereals are deficient, (2) on account of the addition of groundnuts and sesame seeds its energy content is quite high, (3) sesame and groundnuts seeds contain appreciable quantities of polyunsaturated fatty acids which are considered essential for optimal growth of the child [17], and (4) sesame is good

Table 2. Protein values of the vegetable mixture and dishes based on it.

Diets	P cals (%)	N.P.U (op) (%)	N.P.U. (st) (%)	NDp cals (%)
Vegetable mixture	21.0	50.0	73.8	10.0
Curry	15.9	60.1	77.1	9.6
Dahi baray	18.8	57.9	80.8	10.9
Khichri	20.0	56.5	82.2	11.4

source of sulphur–amino acids in which most of the human diets are limiting [18].

In the light of above discussion it can be concluded that the above mixture fulfils the following three basic requirements of a culturally acceptable domestic level vegetable protein mixture: (1) it's protein value in terms of chemical score and NDP cals% is quite high and can serve as a good supplement to cereal based Pakistani diets, (2) it can serve as a nutritious based for our traditional weaning food, and (3) it is low-cost as the food grains and oil seeds are locally available.

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Appendix

Curry

Ingredients

Vegetable mixture	415 g
Vegetable ghee (dalda)	28.5 g
Onions	28.5 g
Curd	240 g
Water	10 Cups
Red pepper	2 tsp
Salt	2 "
Dried coriander seeds	1¼ "
Turmeric	¾ "
Cumin seeds	¾ "
Fresh coriander greens	

Method. Brown onions in ghee, put some water and add sesame seeds, red pepper, salt, dried coriander seeds and cumin seeds, to it. After browning the mixture put some water to make a paste out of it and then gradually

add butter milk to it while stirring constantly. When it starts boiling, put some fresh coriander greens to it.

Dahi Baray

Ingredients

Vegetable mixture	415 g
Vegetable ghee	28.5 g
Curd	300 g
Mustard oil	56 g
Cumin seeds	½ tsp
Red pepper	Tbsp.
Dried coriander seeds	1 tsp
Salt	1 "
Green chillies	1½ "
Baking powder	¼ "

Method. Add water to the vegetable mixture and make a dough, knead it well and keep it for 10 hr. Make individual cakes and add cumin seeds, red pepper and dried coriander seeds to each 'Bara' and fry it in mustard oil. Keep a basin of cold water handy, drop the cakes into the water and allow to soak. Meanwhile prepare curd, grind some red pepper, salt and mix into curd. Add some fresh coriander greens and cumin seeds.

Now remove the cakes from the water and press out any excess water and put them into curd, sprinkle with cumin seeds.

Khichri

Ingredients

Vegetable mixture	415 g
Curd	240 "
Ghee	28.5 g
Onion	28.5 g
Cloves	3
Cumin seeds	¼ tsp
Cardemom	3
Salt	2 tsp
Water	3 Cups

Method. Soak moong dal, gram (coarsely ground) and rice in water before cooking for ½ hr. Melt ghee in a pan, add onions and brown them. Add ½ cup of water and spices. After a while add gram to it and put sufficient water in it to cook. After 10 min add moong dal and pea nuts to it and put about 1 cup of water. When dals become softened, add 1½ cup of water and as it starts boiling, add rice to it. When nearly cooked, close lid of the pan tightly and allow it on low heat for 15 min. Remove when steam issues forth.