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Acceptability appraisal and nutritional quality of food products incorporated with whey protein concentrate and soy flour

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ABSTRACT

Whey is a by-product of cheese or paneer making having a great nutritional value along with potential functional food ingredients. Soy proteins also have a great potential to increase the nutritional and physical qualities of food. Despite this nutritional importance, soy products are not used much due to a characteristic beany flavour and antinutritional factors. To make it a value added product, processing of soy products is of utmost importance. Moreover, soy products are deficient in sulphar containing amino acids, for which there soy products need to be blended with dairy products/cereals/pulses to make them nutritionally adequate and popular in areas where people suffering from PEM inhabit. With this information in mind, the present study was carried out with the objective to remove the beany flavour and antinutritional factors from soy flour by different processing techniques. Acceptability evaluation of some products prepared by incorporating WPC at 10 and 20 per cent level and their respective forms blended with soy flour have been undertaken. Nutritional analysis of most acceptable version of each product was carried out and compared with the standard.

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Key Words : Whey protein concentrate, Defatted soy flour, Nutrient composition, Sensory evaluation

INTRODUCTION

Malnutrition affects all segments of population in India. Among its different forms protein energy malnutrition is the most common. It is not one disease, but a spectrum of conditions arising out of an inadequate diet. To combat malnutrition, protein fortification of food is of interest and importance especially in the light to prevent malnutrition.

In recent years, much attention has been paid to a great variety of functional and nutritional properties of whey and soy proteins. Whey is a collective term referring to the serum or liquid part of milk that remains dissolved in the aqueous portion after the coagulation of casein into curd during the manufacture of cheese, where most of the fat and casein have been used in the cheese-making process. The remnant whey is high in both lactose and minerals (FAO, 2006).

A large part of the whey produced throughout the world as a by-product is drained into gutters, creating problem of pollution, besides loss of valuable nutrients. One of the most promising ways of utilizing dairy by-products in India could be their inclusion in wheat and soy flour for different food products preparation.

Soybean contains 40 per cent protein and 20 per cent oil and can solve the protein calorie malnutrition of ever expanding population in our country. Raw soy is the most concentrated source of trypsin inhibitors. Trypsin inhibitors are not restricted to their effect on trypsin but may also inhibit other proteases that contain serine in the active site. Processing of soybean can reduce the trypsin inhibitors to a large extent.

In the form of soy flour, it can be used as a protein supplement and is generally recommended for making high protein breads, biscuits and other cereal based foods. One important consideration in combining whey protein concentrate with soybean is that soy protein is known to have a balanced amino acid, profile, although, methionine; a sulphur containing amino acid, is limiting in it. On the other hand, whey protein is rich in sulphur containing amino acids.

Thus, soybean and whey combination has the potential to provide low cost nutritious food products which could be exploited to fill the demand supply gap of nutrients and can be utilized in institutional feeding programmes of developing countries like India.

Addition of whey powder is valuable to the functional properties, also act as a source of nutrients to various foods as it contains approximately 50 per cent of the nutrients present in the original milk. Commercially

available whey protein concentrate contains 35 to 75 per cent proteins. Addition of whey and soy flour to food on a solid basis can result in large differences in functionality and nutrient composition due to the differences in protein content.

Thus, the present endeavor has been aimed at making various maida based food and their soy blends, incorporating whey protein concentrate at the levels of 10 and 20 per cent, respectively. For preparing soy blends processed soybean has been used for making soy flour after the removal of antinutritional factors and flavour (Ahmed and Pathak, 2000; Ball *et al.,* 1997). The products to be developed included ghawan, sweet rolls, savain idli khamiri roti and papad. Thereafter, the products have been appraised for acceptability by a panel of semi-trained persons followed by nutrient analysis of the most acceptable variant.

METHODOLOGY

WPC was procured from M/s Mahan Proteins Limited, New Delhi. The composition (AOAC, 1984) and quality attributes of WPC are given in Table a. Other materials like soybean, wheat four, refined oil and salt were procured from local supermarket.

Table a: Quality of whey protein concentrate

Colour	Creamy white
Taste	Bland
pH	6.4
Bulk density g/ml	0.42
Insolubility index ml	1.6
Moisture %	3.8
Fat %	5.0
Protein % (on dry basis)	70.0
Total minerals %	4.5
Total plate count, per g	500
Coliforms, per 0.1g	ND
Salmonella, per 100g	ND
Yeast and mold count, per g	10

ND: Not Detected (n=3)

The study was carried out in three phases, phase I comprised of processing of soybean and preparation of fat free soy flour to reduce the trypsin inhibitor activity (Ball *et al.,* 1997). For this, soyabean was subjected to different processing techniques like cleaning, dehulling, soaking in water (containing 1 per cent w/v sodium bicarbonate), blanching, drying and milling as shown in Fig. a.

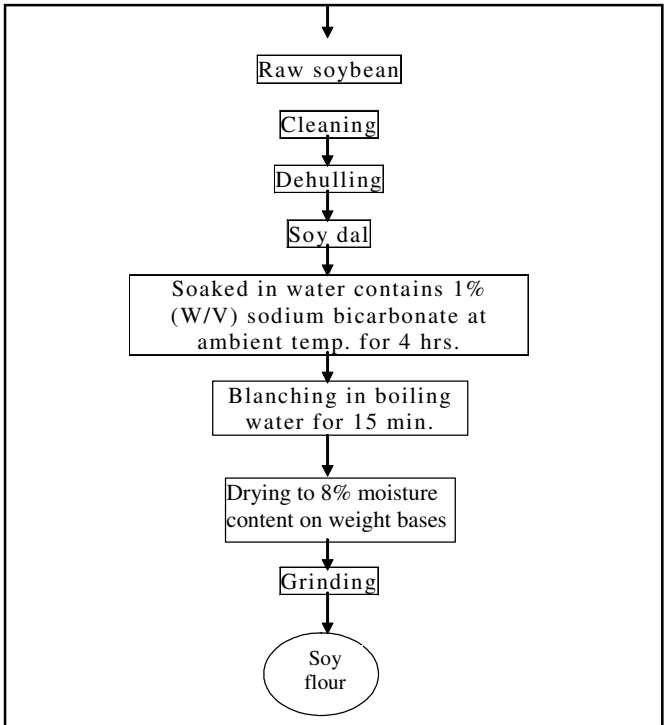

Fig. a: Processed chart to prepare full fat soy flour

Phase II included product development using whey protein concentrate and soy flour with the motive that they appeal to the eye, tickle the palate, provide optimum nutrition, promote health. Five products namely, Ghawan, Khamiri roti, papad, savain, idli and sweet rolls were prepared incorporating WPC and soy blends at different concentrations. Five variants of each product were prepared namely B (10% WPC); C(20%WPC); D (soy blend 50%); E (soy blend 50%+ 10%WPC); F(soy blend 50%+ 20%WPC). The different products prepared were subjected to sensory evaluation by a panel of 25 semi-trained personals on 9-point hedonic scale. The panelists evaluated the products for their appearance, colour, taste, after taste and overall acceptability (Amerine *et al.,* 1965).

The third phase involved proximate analysis of most acceptable variant of each product and were compared to the standard. The evaluation of proximate composition involved the various nutrients *viz.,* protein (Kingsley, 1942), fat (Folch *et al.,* 1957), moisture and ash contents (Sharma, 2007), minerals – calcium (Sharma, 2007), iron (Wong, 1928), phosphorus (Ames, 1960).

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Statistical analysis:

All values have been presented as mean±SD and statistical significance has been analyzed by Student's t-test.

OBSERVATIONS AND ASSESSMENT

The mean scores for WPC incorporated products were found to be higher as compared to the ones incorporated with soy blends except for sweet rolls.

Ghawan and its variants were well accepted in terms of various attributes. The variants C; E and F were

Table 1 (A_1): Effect of different levels of WPC and soy blends on sensory quality of Ghawan

Variants	Appearance	Colour	Taste	After taste	Overall acceptability
A	7.20±1.20	7.20±1.20	7.44±0.96	7.52±1.08	7.36±0.90
B	7.28±0.88	7.14±1.01	7.32±0.86	7.32±0.96	7.28±0.73
C	7.04±0.93	7.58±0.90	7.36±1.10	7.68±0.94	7.44±0.65
D	7.12±1.05	7.04±1.17	7.12±0.95	7.04±0.78	7.08±0.81
E	6.92±0.99	6.96±1.01	6.88±1.05	7.20±0.81	7.16±0.64
F	6.78±0.85	6.76±1.01	7.16±0.90	7.28±0.90	7.40±0.91

A: Standard B: Incorporation of WPC at 10% level C: Incorporation of WPC at 20% level
D: 50% soy blend E: 50% soy blend with 10% WPC F: 50% soy blend with 20% WPC
* indicates significance of value at P= 0.01

Table 1 (A_2): Comparison of proximate composition of the most acceptable variant and standard recipe of Ghawan

Sample	Moisture (g/100g)	Ash (g/100g)	Iron (mg/100g)	Calcium (mg/100g)	Phosphorus (mg/ 100g)	Fat (g/100g)	Protein (g/100g)
A	28.00	4.80	1.90	21.05	105.50	2.3	8.30
C	30.00	5.50	2.5	62*	100.00*	9*	12.17*

A = Standard, C = Incorporation of WPC at 20%
* indicates significance of value at P= 0.01

Table 2 (B_1): Effect of different levels of WPC and soy blends on sensory quality of Khamiri roti

Variants	Appearance	Colour	Taste	After taste	Overall acceptability
A	7.56±0.96	7.76±1.32	6.88±0.85	6.92±0.95	7.20±0.86
B	7.28±0.93	6.40±1.20	6.96±1.05	6.96±1.05	7.26±1.15
C	7.18±0.57	7.24±0.52	6.88±0.78	6.48±0.91	7.06±0.96
D	6.69±1.38	7.88±0.85	6.84±1.09	6.58±1.20	7.60±1.14
E	7.72±0.84	7.24±0.96	6.52±1.22	6.18±1.16	6.92±1.02
F	6.56±1.27	7.14±1.01	6.64±1.30	6.64±1.26	6.98±1.32

A: Standard B: Incorporation of WPC at 10% level C: Incorporation of WPC at 20% level
D: 50% soy blend E: 50% soy blend with 10% WPC F: 50% soy blend with 20% WPC
* indicates significance of value at P= 0.01

Table 2 (B_2): Comparison of proximate composition of the most acceptable variant and standard recipe of Khamiri roti

Sample	Moisture (g/100g)	Ash (g/100g)	Iron (mg/100g)	Calcium (mg/100g)	Phosphorus (mg/ 100g)	Fat (g/100g)	Protein (g/100g)
A	25.50	2.98	2.10	22.33	109.90	3.00	7.03
B	28.80	3.43	2.90	52.00*	148.97*	8.50*	11.65*

A = Standard B = Incorporation of WPC at 10% * indicates significance of value at P= 0.01

Table 3 (C_1): Effect of different levels of WPC and soy blends on sensory quality of papad

Variants	Appearance	Colour	Taste	After taste	Overall acceptability
A	7.24±0.56	7.72±0.54	7.84±0.89	7.48±1.12	7.56±0.82
B	7.14±0.52	7.44±0.83	7.34±0.68	7.16±0.89	7.18±0.57
C	6.76±0.83	7.20±0.91	7.59±0.74	7.18±0.91	7.20±0.95
D	7.16±0.99	7.52±0.86	7.64±0.74	7.44±0.78	7.50±0.60
E	6.44±1.45	7.24±0.99	7.60±0.94	7.08±0.86	7.38±0.77
F	6.52±1.10	7.50±0.64	7.55±0.94	7.28±1.19	7.45±0.85

A: Standard B: Incorporation of WPC at 10% level C: Incorporation of WPC at 20% level
D: 50% soy blend E: 50% soy blend with 10% WPC F: 50% soy blend with 20% WPC
* indicates significance of value at P= 0.01

Table 3(C_2): Comparison of proximate composition of the most acceptable variant and standard recipe Papad

Sample	Moisture (g/100g)	Ash (g/100g)	Iron (mg/100g)	Calcium (mg/100g)	Phosphorus (mg/ 100g)	Fat (g/100g)	Protein (g/100g)
A	4.80	3.36	3.00	22	128.10	17.00	11.29
D	7.10	3.61	8.30	138*	283.26*	20.0*	22.10*

A = Standard D = 50% of soy blend * indicates significance of value at P= 0.01

Table 4 (D_1): Effect of different levels of WPC and soy blends on sensory quality of Savain idli

Variants	Appearance	Colour	Taste	After taste	Overall acceptability
A	6.96±0.86	7.12±0.88	6.96±1.09	6.98±1.15	7.30±1.01
B	6.92±1.22	7.00±1.00	6.48±1.04	7.00±1.15	7.76±1.13
C	6.80±0.91	7.04±0.93	6.80±0.86	7.00±1.17	7.18±1.05
D	6.88±0.96	7.00±1.00	7.04±1.17	6.56±0.96	7.00±1.08
E	6.76±1.13	7.00±1.15	6.88±1.16	6.80±1.10	7.36±1.18
F	6.60±0.95	6.98±1.15	6.76±1.16	6.78±0.91	7.26±1.10

A: Standard B: Incorporation of WPC at 10% level C: Incorporation of WPC at 20% level
D: 50% soy blend E: 50% soy blend with 10% WPC F: 50% soy blend with 20% WPC
* indicates significance of value at P= 0.01

Table 4(D_2): Comparison of proximate composition of the most acceptable variant and standard recipe Savain idli

Sample	Moisture (g/100g)	Ash (g/100g)	Iron (mg/100g)	Calcium (mg/100g)	Phosphorus (mg/ 100g)	Fat (g/100g)	Protein (g/100g)
A	52.08	8.05	1.75	19.90	98.03	7.00	10.01
B	56.70	10.61	2.30	98.00*	101.40*	20.0*	16.15*

A = Standard B = Incorporation of WPC at 10% * indicates significance of value at P= 0.01

Table 5 (E_1): Effect of different levels of WPC and soy blends on sensory quality of sweet rolls

Variants	Appearance	Colour	Taste	After taste	Overall acceptability
A	7.20±0.70	7.58±0.64	7.32±1.10	7.64±1.07	7.28±1.06
B	7.30±0.76	7.48±0.66	7.96±0.85	7.62±1.06	7.16±1.08
C	7.00±0.91	7.24±0.83	7.04±0.84	7.32±0.93	7.20±0.95
D	7.16±0.77	7.68±0.80	7.52±0.89	7.26±0.75	7.30±0.86
E	7.44±0.85	7.78±0.88	7.24±1.17	7.16±1.21	7.64±1.03
F	7.36±0.82	7.44±0.86	7.28±1.13	7.00±1.35	7.18±1.06

A: Standard B: Incorporation of WPC at 10% level C: Incorporation of WPC at 20% level
D: 50% soy blend E: 50% soy blend with 10% WPC F: 50% soy blend with 20% WPC
* indicates significance of value at P= 0.01

Table 5 (E_2): Comparison of proximate composition of the most acceptable variant and standard recipe sweet rolls

Sample	Moisture (g/100g)	Ash (g/100g)	Iron (mg/100g)	Calcium (mg/100g)	Phosphorus (mg/ 100g)	Fat (g/100g)	Protein (g/100g)
A	19.13	2.98	2.65	20.05	52.73	40.00	11.15
E	24.00*	2.89	6.37*	170*	265.60*	47.0*	26.20*

A = Standard D =50% soy blend with 10% WPC * indicates significance of value at P= 0.01

significantly different (p=0.01) from standard. Variant C was the most accepted as compared to the other variants and on comparing the proximate composition with standard, a significant difference was observed in fat, protein, calcium and phosphorus content.

No significant difference (p=0.01) was observed between standard and test samples of Khamiri Roti.

The mean score for overall acceptability of sample B was highest (7.26±1.15) as shown in the Table 2 (B_1). Marked difference was observed in protein, calcium, fat and phosphorus content between sample A and B as evident from Table 2 (B_2).

In papad significant difference was observed between standard and test samples for all the attributes of sensory evaluation Table 3 (C_1). The nutrient analysis of standard and sample D were carried out as shown in

the Table 3 (C_2). A significant difference was observed in protein, fat, calcium and phosphorus content between standard and test sample D.

In product IV Savian Idli, no significant difference was observed between test and standard samples (p=0.01).The nutrient analysis of standard and sample B revealed marked difference in protein, calcium, fat and phosphorus content. (Table 4 D_1 and D_2)

In Sweet rolls, there was no significant difference observed for appearance, colour, taste, after taste and overall acceptability between standard and test samples (p=0.01). However a significant increase was observed in sample E in fat, protein, moisture, iron, calcium and phosphorus content as compared to standard (Table 5 E_1 and E_2).

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