Influence of different protein sources on cooking and sensory quality of pasta

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ABSTRACT

Supplementation of pasta with different protein sources (legumes, milk proteins, egg protein) was done. Cooking and sensory quality of pasta was assessed. Statistically, a non-significant variation ($P \leq 0.05$) was observed in the minimum cooking time of resultant pasta but significant correlations ($r=0.95$) was obtained between the volume expansion and the percent water absorption of supplemented pasta. Leaching of solids of supplemented pasta was higher in cooked water in comparison to control. Sensory attributes (appearance, flavour and taste) of pasta improved with the addition of legumes, WPC (Whey protein concentrate) and egg albumen resulted in increase in acceptability score. Supplementation of protein sources enhanced the nutritional and organoleptic value of the resultant pasta. Among all the protein sources used at variable levels, the 15% mung bean flour, 10% whey protein concentrate and 6% egg albumen yielded the best quality pasta.

Keywords: Cooking and sensory quality, enrichment, egg protein, legume flour, milk protein, pasta.

1 INTRODUCTION

Health and convenience are the two major factors during today's development of breakfast snack and variety products. At the same, time strapped consumers have sparked the development of convenient and nutritious food products. Realizing the malnutrition problems of low-income group people and preschool children, the need of upgrading of nutrition is becoming a major concern. In some areas poor economy, scarcity of certain foodstuffs is becoming the reason of malnutrition. Pasta is low in calories, low in fat, cholesterol free and sodium free. Pasta is good source of thiamine, iron, riboflavin and niacin. As a carbohydrate, Pasta is a good energy source for body and brain.

Pasta products are high in starch, but low in proteins and dietary fibers and are mainly made up of hard wheat flour which is deficient in lysine, an essential amino acid. Now a days, it has became important to improve the quality of pasta by the addition of other ingredients. Pasta products, largely consumed all over the world are traditionally manufactured from durum wheat semolina, known to be the best raw material suitable for pasta production [1]. Pasta is one of the primary extruded foods made from durum wheat. Utilization of durum wheat for snack foods have been well identified [2]. As wheat derived staple food, pasta is second to bread in world consumption [3]. Its worldwide acceptance is attributed to its low cost, ease of preparation, versatility, sensory attributes and long shelf life.

Adding protein to food products is relatively simple provided that protein sources have been identified. The most frequently considered sources of protein for fortification include cereal grains (wheat), eggs (whole, white, yolk), milk (white, non fat dry) and other dairy products and legumes [4]. Although legume proteins are low in essential amino acids, they are considered to be the cheapest protein and most convenient high protein materials. It is well known that legume flours and their protein concentrates are in high in lysine.

Some researchers have reported supplementation of pasta and noodles with different sources like egg white, cowpea meal, mung bean flour, pigeon pea etc which are rich in protein [5,6,7]. Therefore the present investigation was carried out to assess the pasta quality by enriching with variable protein sources.

2 MATERIAL AND METHODS

2.1 LEGUME FLOUR (COWPEA, MUNG BEAN, PIGEON PEA)

Commercial Samples Of Legumes Purchased From Local Grocery Store Were Used For Flour Preparation. Cowpea Was Soaked In Water For Overnight In Ratio Of 1:2 At 30°c. After Removing Excessive Water, Soaked Grains Were Dried In A Forced Air Circulation Drier For 8 Hr At 38°c. The Dried Grains Were Passed Through Pulse Dehulling Machine To Remove The Hulls For Dehulling The Grains. Resultant Mung Bean And Pigeon Pea Dhals Were Dried At 50°c In A Forced Air Ciculation Drier. After Drying, Dhals Were

Ground In Cemotec Mill (Foss) (Setting No1) Followed By Sieving.

2.2 Milk proteins

Whey protein concentrate and casein were procured from "Cepham Milk Specialities Ltd. Derabassi". Skim milk powder was purchased from Milkfed "Verka Milk Plant", Ludhiana.

2.3 Egg protein

Fresh eggs were purchased from local grocery store and were used as a source of protein as whole. Egg white and yolk were separated manually.

2.4 Semolina

Commercial wheat semolina was purchased from the local market.

2.5 Preparation of blends

Legume flour (cowpea, mungbean, pigeon pea) were blended into semolina ranged from 5-25%, milk proteins (whey protein concentrate, skim milk powder) at 5,10 and15% levels and casein 2, 4 and 6%, egg proteins (whole and albumen) were blended with semolina at 4, 6 and 8% levels.

2.6 Proximate composition

Moisture, ash, protein, fat, carbohydrate and fiber of different raw materials were estimated using standard procedure [8].

2.7 Pasta preparation

Prepared blends (wheat semolina and protein sources) were mixed with water containing 2 % salt. The amount of water used in formulation varied from 26-34 % by weight. The optimum water absorption of flour for pasta making was determined based on appearance, shaping, sheeting and handling properties of dough during the process after conducting the trials.

Flour was mixed with optimum amount of water in the mixing chamber of pasta extruder (Le monferrina, Masoero Arturo and C.S.N.C, Italy) for 10 min to distribute water uniformly throughout the flour particles. The moist flour aggregate was placed in a metal extruder attachment of the pasta machine fitted with an adjustable die followed by cutting. After preparation of pasta, drying of pasta was carried out in hot air oven at 45-50^{o}C for about 4-5 hr to attain moisture content to about 5-6%.

2.8 Cooking quality of pasta

The cooking quality of pasta was determined by measuring minimum cooking time, percent water absorption, volume expansion, gruel solid loss [8].

2.9 Sensory evaluation

Cooked pasta was evaluated for overall acceptability contributed by different sensory attributes (appearance, colour, texture, stickiness, flavor and taste) through a panel of semi-trained judges [9].

2.10 Statistical analysis

Proximate composition was expressed at 14 per cent moisture and experiments were carried out in triplicate and data was analyzed with the help of factorial design [10].

3 RESULTS AND DISCUSSION

3.1 Proximate composition

Proximate composition of the variable protein sources is presented in Table 1. All the sources possessed statistically significant variation with respect to their chemical constituents. Protein sources used for formulation of pasta were rich in protein. Among the legume sources cowpea possessed highest protein. Casein was the richest milk protein source. Egg albumen was concentrated source of protein than whole egg. Other proximate constituents also varied significantly.

3.2 Effect of legume supplementation on the quality of pasta

Data presented in table 2 symbolized the cooking and the sensory quality of pastas supplemented with legumes (cowpea, mung bean and pigeon pea).

Supplementation of legume flours (cowpea, mungbean, pigeonpea) had enhanced the cooking and sensory quality of pasta significantly. Legumes supplementation had increased the minimum cooking time of the resulted pasta as compared to control. During pasta cooking, there is competition between starch and protein for water [11]. When less protein surrounds starch granules, they swell and gelatinize faster [12].

A significant variation with respect to the water absorption and volume expansion of legume-supplemented pasta was observed from Table 2. Significant correlation ($P \leq 0.05$, $r = 0.95$) was found between volume expansion and percent water absorption of legume-enriched pasta. Legume supplementation had given a salutary effect on the water absorption of pasta. With increase in level of legume flour, leaching of solids in cooked water did not increase significantly. These results are well supported by earlier studies. Duszkiewicz *et al*. [13] observed higher water absorption and cooking loss in spaghetti blended with legume flour and concentrates. Bergman *et al* [6] reported higher cooking losses in pasta supplemented with cowpea, as compared to control durum semolina pasta. Legume supplementation of pasta resulted in greater cooking loss when compared to control [14].

Mean overall acceptability score of pasta supplemented with cowpea and pigeon pea varied non-significantly except for mung bean flour supplemented pasta. Mung bean supplemented pasta got highest scores during organoleptic evaluation for better appearance, color, texture and flavour. However, all the three legume protein enrichments have produced good quality pasta. Sharma *et al* [15] reported that the overall acceptability scores of cookies increased significantly with increase in level of cowpea flour up to 15% thereafter it decreased. Similarly, based on the sensory and instrumental studies, Zhao *et al* [16] concluded that spaghetti could be fortified with 15-20% legume flour without substantial changes in pasta characteristics.

3.3 Effect of supplementation of milk protein on the quality of pasta

Data in table 3 connoted the quality characters of pasta supplemented with milk proteins (casein, skim milk powder and whey protein concentrate). Incorporation of milk proteins to wheat semolina had enhanced the quality of supplemented pasta. Supplementation of milk proteins increased the time taken by the starch to gelatinize than control but with a statistically non-significant variation. Higher water absorption was observed with increase in the level of supplementation of milk proteins. Percent increase in water absorption was 9.9 in casein-supplemented pasta. Similarly, percent increase in water absorption was 7.5 and 3 in skim milk and whey protein concentrate supplemented pasta than control, respectively. Expansion in volume of resultant pasta was significantly higher than the semolina pasta. There was no effect of supplementation on gruel solids loss during cooking. Glabe *et al* [17] and Paulsen [18] stated that the fortification of pasta with non-fat dry milk tended to yield higher solids in cooking water than did unfortified pasta.

Pasta supplemented with milk protein (casein, skim milk powder and whey protein concentrate) was of high acceptability than wheat semolina pasta. Acceptability score of pasta varied non-significantly with the addition of casein and WPC, however skim milk powder supplementation showed significant effect on acceptability of pasta. Increased levels of casein contributed to the hardness of pasta, which affected the product acceptability. Whey protein concentrate supplemented pasta got maximum acceptability for different sensory attributes from panelists in comparison to other milk protein enriched pasta. Niturkar *et al* [19] reported that fortification of milk protein enhanced the vermicelli thread length with improvement in colour and texture. An improvement in sensory qualities of vermicelli was brought about with 4 % protein fortification.

3.4 Effect of supplementation of egg protein on the quality of pasta

Table 4 summarized the quality characters of pasta supplemented with egg protein. Supplementation with egg albumen proved more effective in improving quality of the pasta in comparison to whole egg. Egg protein supplementation increased minimum cooking time of pasta similarily as reported from the legume and milk protein supplemented pasta. Das and Chattoraj [20] reported that cooking time of noodles become longer with higher protein content.

As the level of egg protein increased in supplemented pasta, there was an increase of 12.4% for absorption of water in whole egg supplemented pasta than control. Similarly upto 8% albumen supplemented pasta absorbed 27% more water than control. Das and Chattoraj [20] assessed that in case of commercial noodles containing egg, higher percent of water was absorbed during cooking.

Supplementation significantly increased the expansion volume of pasta. A significant correlation ($P \leq 0.05$, $r = 0.86$) was found between volume expansion and water absorption. Loss of solids in cooked water increased with increase in level of whole egg and egg albumen in semolina. Walsh and Gills [21] stated that high protein content is related with high cooking loss, however the variation was non significant.

Whole egg did not contribute towards the overall acceptability of pasta due to typical flavor of yolk. But the sensory score improved with the supplementation of egg albumen. Khouryiesh *et al* [22] studied the sensory properties of egg noodles and found that addition of whole egg improved the texture of the noodles.

Conclusively Figure 1 illustrates the quality of pasta enriched with variable protein sources. Among legumes, mean overall acceptability was highest for mung bean pasta than cowpea and pigeon pea pasta in terms of better colour, texture and flavor. Thus out of three legumes mung bean at 15% was selected best as a protein source.

4 TABLES

Table 1: Proximate composition* of raw materials

Raw material	Crude protein (%)	Ash (%)	Fat (%)	Fiber (%)	Carbohydrate (%)
Semolina	11.30±0.10	0.45±0.02	1.10±0.02	0.2±0.05	72.95±0.27
Cowpea flour	25.10±0.15	3.40±0.18	1.21±0.08	0.9±0.35	55.37±0.44
Mung bean flour	24.70±0.21	3.35±0.10	2.00±0.02	1.7±0.23	54.25±0.20
Pigeon pea flour	22.10±0.10	3.30±0.30	1.40±0.44	0.8±0.03	58.40±0.40
Casein	84.0±0.41	1.50±0.20	0.50±0.22	-	-
Skim milk powder	35.69±0.56	7.70±0.05	0.40±0.30	-	42.21±0.26
Whey protein concentrate	34.30±0.27	6.60±0.3	1.80±0.14	-	43.30±0.30
Egg whole	41.60±0.44	2.80±0.03	33.37±0.19	-	8.23±0.35
Egg albumen	72.70±0.23	3.13±0.13	0.57±0.07	-	9.60±0.40
CD ($P \leq 0.05$)	**0.32**	**0.27**	**0.78**	**NS**	**0.11**

* Expressed at 14% moisture basis ($P \leq 0.05$) (n = 3)
NS – Non significant

Table 2 : Cooking and sensory quality of legume protein supplemented pasta

Level of supplementation, (%)	Minimum cooking time (min.)	Water absorption, (%)	Volume expansion, (ml/gm)	Gruel solid loss, (%)	Overall acceptability, score out of 9.0
Cowpea					
0	7:00±0.16	185.9±0.45	0.90±0.02	2.01±0.01	8.0±0.29
5	7:30±0.13	187.0±0.29	0.90±0.31	2.49±0.02	8.1±0.10
10	7:50±0.11	193.8±0.38	0.91±0.01	3.01±0.02	8.1±0.21
15	7:52±0.09	196.4±0.44	0.92±0.10	3.49±0.05	8.2±0.20
20	7:55±0.02	199.1±0.10	0.94±0.04	3.51±0.04	8.1±0.51
25	7:58±0.03	211.7±0.40	0.98±0.12	3.99±0.03	7.9±0.10
CD ($P < 0.05$)	**NS**	**3.31**	**0.035**	**NS**	**NS**
Mungbean					
0	7:00±0.16	185.9±0.46	0.90±0.02	2.01±0.01	8.0±0.29
5	7:05±0.01	191.3±0.30	0.95±0.04	2.52±0.03	8.0±0.29
10	7:06±0.009	194.3±0.10	0.97±0.03	3.48±0.03	8.2±0.20
15	7:15±0.01	198.3±0.30	0.96±0.03	4.02±0.02	8.5±0.40
20	7:25±0.13	200.4±0.40	0.97±0.08	3.52±0.03	8.5±0.25
25	7:33±0.03	211.6±0.55	0.97±0.03	4.98±0.02	8.03±0.02
CD ($P < 0.05$)	**NS**	**1.84**	**0.035**	**NS**	**0.33**

Pigeon pea					
0	7:00±0.16	185.9±0.46	0.90±0.02	2.01±0.01	8.0±0.29
5	7:15±0.01	195.1±0.11	0.96±0.02	2.50±0.12	7.8±0.22
10	7:22±0.01	196.7±0.34	0.97±0.02	3.48±0.01	8.0±0.76
15	7:25±0.13	197.2±0.20	0.97±0.09	4.02±0.02	8.3±0.29
20	7:35±0.03	197.4±0.35	0.98±0.10	3.52±0.01	8.2±0.10
25	7:40±0.04	198.5±0.35	0.99±0.10	5.01±0.01	8.0±0.34
CD (P < 0.05)	**NS**	**2.37**	**0.038**	**NS**	**NS**

NS – Non significant (P ≤ 0.05) (n = 3)

Table 3 : Cooking and sensory quality of milk protein supplemented pasta

Level of supplementation, (%)	Minimum cooking time, (min.)	Water absorption, (%)	Volume expansion, (ml/gm)	Gruel solid loss (%)	Overall acceptability, score out of 9.0
Casein					
0	7:00±0.16	185.9^{a}±0.45	0.90^{a}±0.02	2.01±0.01	8.0±0.03
2	7:29±0.10	187.4^{a}±0.29	1.30^{b}±0.04	2.01±0.01	8.12±0.03
4	7:45±0.09	194.5^{b}±0.20	1.36^{c}±0.02	2.49±0.09	8.28±0.10
6	8.15±0.008	206.5^{c}±0.08	1.50^{d}±0.10	3.01±0.03	7.76±0.32
CD (P < 0.05)	**NS**	**3.77**	**0.038**	**NS**	**NS**
Skim milk powder (SMP)					
0	7:00±0.16	185.9±0.46	0.90±0.02	2.01±0.01	8.0±0.29
5	7:15±0.008	189.6±0.10	0.95±0.02	2.49±0.09	8.1±0.23
10	7:25±0.02	195.6±1.47	0.96±0.03	3.51±0.02	8.24±0.04
15	7:35±0.02	200.9±0.17	0.99±0.07	4.02±0.02	8.1±0.14
CD (P < 0.05)	**NS**	**0.42**	**0.038**	**NS**	**0.19**
Whey protein concentrate (WPC)					
0	7:00±0.16	185.9±0.46	0.90^{a}±0.02	2.01±0.01	8.0±0.29
5	7:05±0.03	186.9±0.26	0.93^{a}±0.02	2.48±0.01	8.2±0.08
10	7:10±0.04	190.5±0.38	0.95±0.01	3.52±0.02	8.3±0.08
15	7:15±0.008	191.5±0.32	0.99±0.09	4.02±0.01	8.3±0.007
CD (P < 0.05)	**NS**	**0.39**	**0.034**	**NS**	**NS**

NS – Non significant (P ≤ 0.05) (n = 3)

Table 4: Cooking and sensory quality of egg protein supplemented pasta

Level of supplementation, (%)	Minimum cooking time, (min.)	Water absorption, (%)	Volume expansion, (ml/gm)	Gruel solid loss (%)	Overall acceptability, score out of 9.0
Egg whole					
0	7:00±0.16	185.9±0.45	0.90±0.02	2.01±0.01	8.0±0.29
4	8:00±0.11	190.9±0.52	1.36±0.01	2.51±0.02	7.8±0.25
6	8:35±0.02	195.2±0.11	1.42±0.04	2.99±0.04	7.8±0.25
8	8:55±0.12	209.0±0.10	1.50±0.06	4.02±0.01	7.8±0.10
CD (P < 0.05)	**NS**	**1.92**	**0.038**	**NS**	**NS**
Egg albumen					
0	7:00±0.16	185.9±0.46	0.90±0.02	2.01±0.01	8.0±0.29
4	8:10±0.06	188.60±0.18	0.95±0.03	2.51±0.03	8.2±0.10
6	8:40±0.04	193.75±0.20	1.25±0.04	4.02±0.02	8.2±0.04
8	9:00±0.16	235.20±0.10	1.42±0.02	5.02±0.03	8.1±0.10
CD (P < 0.05)	**NS**	**0.33**	**0.038**	**NS**	**NS**

NS – Non significant (P ≤ 0.05) (n = 3)

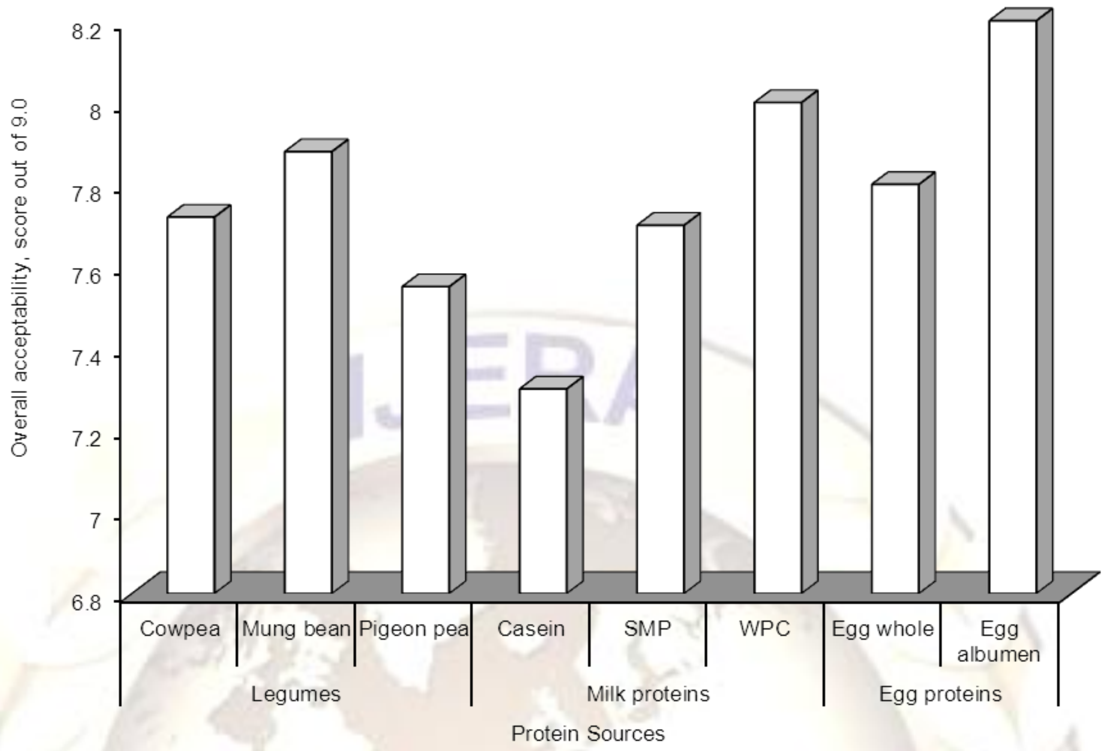

Fig. 1: Overall acceptability of enriched pasta

5 CONCLUSION

Comparison between different milk proteins had shown that the whey protein concentrates yielded quality pasta with higher mean acceptability score at 10% fortification level.
Among all the protein sources used at variable levels, the 15% mung bean flour, 10% whey protein concentrate and 6% egg albumen yielded the best quality pasta.

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