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Development and quality evaluation of fortified biscuits based on whey protein concentrate and curry leaves

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Abstract
The present study was carried out with supplementing wheat flour with whey protein concentrate and curry leaves at different levels of substitution and varying proportions of whey protein concentrate – 10%, 20% and 30% and curry leaves powder – 5%, 7% and 9%. Sensory evaluation of the biscuits was carried out using 9 point hedonic scale. The data obtained during the study was analysed statistically using analysis of variance and critical difference techniques. On the basis of results it was concluded that the treatment T_5 containing 20% whey protein and 7% curry leaves powder was the best regarding sensory characteristics – colour and appearance, taste and flavour, body and texture and overall acceptability of the product. Analysis showed that the moisture content of the biscuits varied from 1.24 – 2.33 and the highest moisture content was found in T_6 containing highest amount of WPC and CLP, the moisture content also increased with the storage time. Estimation of protein content of sample showed high improvement in nutritional value of WPC enriched biscuits with a value of 25.47%. There was a linear increase in ash content of the product from 0.31 – 1.19. Based on the results it was concluded that the whey protein enriched biscuits containing 20% WPC and 7% curry leaves powder were high as comparable to control and other treatments in sensory characteristics (colour, flavour and taste, body and texture and overall acceptability).

Keywords: curry leaves powder, whey protein concentrate

Introduction
Fortification of foods is of current interest because of nutritional awareness of consumers. Supplementation with legumes is one way to meet the needs for protein foods, particularly baked foods. Biscuits are widely consumed that have relatively long shelf life and good eating qualities. Such qualities of food products make large scale production and distribution possible, in the shortest period. Biscuits can be easily fortified with protein rich flours to provide convenient food in order to supplement protein in the diet. Today's health conscious consumers are increasingly making food choices based on a food's ability to provide health benefits, such as enhancing body functions or reducing the risk for certain diseases. Many traditional dairy ingredients provide unprecedented opportunities for the food industry to improve existing and/or develop new products with unique health benefits. New technologies to isolate dairy ingredients and emerging research identifying biological roles for dairy ingredients, such as whey proteins, are leading to growing interest in their potential use in functional foods (Smithers *et al.,* 1996) [10]. Whey has all along been considered as a waste product and looked upon seriously by the environmentalists and technologists due to its potent polluting strength. However, it is no longer considered a waste product but a treasure chest of nutritionally rich whey protein, which has been unlocked by the modern processing technology, enabling them to recover economically in their native form. The advent of this technology has been a great boon to recover these precious solids in the form of whey protein concentrate (WPC). The whey proteins are potentially nutritional and functional food ingredients for use in a wide range of food types and can replace expensive ingredients such as egg white and milk proteins (Jayaprakasha, 1992).

Curry leaves are a good source of vitamin A and they provide a rich source of calcium. They are primarily used in providing a flavor in Indian cooking especially in the south Indian cooking while preparing the sambar or rasam. These leaves have several herbal remedial qualities and are mainly derived from an aromatic and deciduous shrub. Curry leaves are highly aromatic. Curry leaves strengthens stomach functioning. Whey protein is a mixture of some of the proteins naturally found in milk. The major proteins found in whey include beta-lacto globulin and alpha-lactalbumin. Whey protein has one of the highest protein digestibility-corrected amino acid scores (PDCAAS; a measure of protein bioavailability) and is more rapidly digested than other proteins, such as casein **(**Dalgleish D. G. *et al.1997***)** [2]**.**

Biscuits are an important baked product in human diet and are usually eaten with tea and are also used as weaning food for infants. The ingredients are simple; they contain soft wheat flour, shortening, sugar, fat, eggs. These ingredients are considered to be low in nutritive and biological values since soft wheat flour used for the production of biscuits is deficient in several nutrients including some vitamins and contains only

7 to 10% protein (Yamazaki and Greenwood, 1981) [12]. The need of production of biscuits with a suitable amount and high biological value of protein will help in developing of nutritionally balanced biscuits to produce high density protein biscuits. The present study was carried out to find out the effect of addition of different proportion of Whey Protein Concentrate and curry leaves on nutritional composition and sensory characteristics of biscuits. The phytoestrogens of soy proteins may reduce cancer risk or interfere with the cancer process. Isoflavones can also help to prevent osteoporosis and cancers, such as colon, breast, and prostate, and offers women relief formenopausal discomfort (Genta *et al.,* 2002) [3]. Moreover, cardiovascular risk disease may be diminished since protein soy reduces blood cholesterol levels, low-density lipoprotein (LDL) cholesterol fraction, and triglycerides in humans (Redondo *et al.,* 2008) [7].

Materials and methods

Biscuits were prepared using creamery method for making biscuit dough. The ingredients used in biscuits were flour blends (100%), sugar (40%), shortening (35%), skim milk powder (2.0%), sodium chloride (1%), sodium bicarbonate (1%), vanilla essence (0.4ml), water (20ml). Six five blends, prepared with wheat flour and whey protein concentrate were 90:10, 80:20, 70:30% and the level of curry leaves powder was 0%. Then curry leaves powder was added at a level of 5, 7, 9% and whey protein concentrate was maintained at level of 20% respectively. The dough was sheeted to a thickness of 3mm with the help of an aluminium platform and frame. The sheeted dough was cut in to a round shape using a moulder. The cut dough was transferred to aluminium tray. The biscuits were baked in an electric oven maintained at 160℃ for 40 minutes. The baked biscuits were cooled for about 35 minutes, packed into LDPE bags for further analysis.

Nutritional composition

Moisture content, Ash content, Fat content, Crude Fiber and Protein content in different biscuits samples were determined as per standard methods (AOAC, 2000). Total carbohydrates value was obtained by subtracting total of moisture, protein, fat, crude fiber and ash content from 100.

Result and discussions

Multi-Grain biscuit packed full of dietary fibre and lean protein. These are good for present time's fast life style. These great tasting biscuits are made of all natural ingredients and formulated to give a nutrient packed meal replacement to help control your calorie intake. Each biscuit contains only 100 calories while supplying 8 g of dietary fibre and 5 g of protein. Multi-Grain biscuits are helpful through the three major challenges of weight loss, overcoming the desire to eat, controlling hunger and nutrition balance. It is mainly through the use of healthy and nutritious low-calorie food to help develop healthy eating habits.

On evaluation of result it was found that there was an increase in moisture content and ash content in biscuit samples with increase in the level of whey protein concentrate. The highest level of ash content 1.26 of the sample T_6 during 15 days and lowest value 0.23 of the sample of T_0. Similar results were reported by Hahn *et al.* (1990) [4] oat to contain 1.56 per cent ash. Tariqual *et al.* (2007) [11] reported ash content 1.56 per cent ash. Tariqual *et al.,* (2007) [11] reported ash content in soybean flour 2.1 per cent. Mebpa *et al.* (2007) [6] reported 0.90 per cent ash in wheat flour. The highest value of moisture content 2.89 of the sample of T_5 during 15 days. Similarly, the physical changes in dried food products are frequently caused by storage in inappropriate conditions. As a result, the shelf life of the products may be significantly reduced. For example, when dehydrated foods are stored at high humidity, the process of moisture uptake will take place. As a result, the products become soggy, leading to degraded quality and shortened shelf life (Singh, 2000) [9]. Moreover, when food powders are exposed to moist atmospheres or elevated storage temperatures, the phenomenon of caking or spontaneous agglomeration will occurs due to the sorption of moisture. The main reason for these occurrences is an inadequate barrier being provided by the packaging (Robertson, 2006) [8]. Second evaluation of the result it was found value of the fortified biscuits in the table decrees with decreases and the lowest value in fat content 20.43 of the samples of T_6 during 30 days and lowest value is 0.18 of T_6 sample at fresh sample and highest is 0.43 of T_0 during 30 days and the protein content highest 25.47 of T_0 sample at fresh sample and lowest value of the samples 09.41 of the T_6 sample during 45 days. The value of decrease is decrease the main reason is the storage because mostly protein content decrease with decrease during storage and temperature condition and second is the curry leaves blended in the samples.

Sensory attributes of all biscuit samples packed in LDPE were evaluated in fresh condition at ambient temperature. Hedonic scale rating was used for evaluation of biscuit samples. Different attributes selected were colour, flavour, taste, texture and overall acceptability. The mean overall acceptability scores of more than 8.5 for biscuit sample containing 10% whey protein concentrate indicated the commercial scope for manufacturing good quality high protein biscuits.

Table 1: Change the ash content of fortified biscuits samples during storage periods.

Ash Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	0.31	0.24	0.23	0.24
T_1	0.49	0.52	0.40	0.45
T_2	0.67	0.71	0.59	0.66
T_3	1.11	0.83	0.74	0.86
T_4	1.16	1.22	0.86	1.03
T_5	1.17	1.24	0.90	1.06
T_6	1.19	1.26	0.93	1.08

Table 2: Analysis by ANOVA Test

F- Test	S	S	S	S
S. Ed (±)	0.157	0.264	0.144	0.199
C.D. (P=0.05)	0.333	0.559	0.305	0.422

Table 2: Change the fat content of fortified biscuits samples during storage periods.

Fat Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	22.10	21.8	21.58	21.70
T_1	21.79	21.59	21.24	24.44
T_2	21.39	21.23	20.63	20.92
T_3	21.27	21.09	20.83	20.94
T_4	21.19	20.93	20.74	20.74
T_5	21.07	20.79	20.57	20.61
T_6	20.93	20.75	20.43	20.58

Table 3: Analysis by ANOVA Test

F- Test	S	S	S	S
S. Ed (±)	0.321	0.303	0.241	0.454
C.D. (P=0.05)	0.681	0.641	0.510	0.963

Table 4: Change the crude protein content of fortified biscuits samples during storage periods.

Protein Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	25.47	25.33	25.21	25.09
T_1	24.03	23.87	23.74	23.61
T_2	22.23	22.17	22.07	22.01
T_3	21.38	21.20	20.96	21.78
T_4	17.82	17.66	17.33	17.03
T_5	15.79	15.25	15.08	14.91
T_6	10.45	10.08	19.78	9.41

Table 5: Analysis by ANOVA Test

F- Test	S	S	S	S
S. Ed (±)	0.391	0.602	0.384	0.468
C.D. (P=0.05)	0.829	1.276	0.813	0.991

Table 6: Change the crude fiber content of fortified biscuits samples during storage periods.

Crude Fiber Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	0.37	0.42	0.43	0.40
T_1	0.31	0.37	0.40	0.37
T_2	0.28	0.34	0.37	0.33
T_3	0.26	0.31	0.34	0.31
T_4	0.24	0.27	0.30	0.27
T_5	0.20	0.24	0.27	0.22
T_6	0.18	0.20	0.21	0.19

Table 7: Analysis by ANOVA Test

F- Test	S	S	S	S
S. Ed (±)	0.015	0.008	0.021	0.022
C.D. (P=0.05)	0.032	0.017	0.045	0.047

Table 8: Change the moisture content of fortified biscuits samples during storage periods.

Moisture Content				
Treatments	0 Days	15 Days	30 Days	45 Days
T_0	1.24	1.71	2.23	1.99
T_1	1.60	1.97	2.62	2.28
T_2	1.89	2.15	2.71	2.47
T_3	2.18	2.20	2.78	2.59
T_4	2.22	2.26	2.85	2.64
T_5	2.28	2.32	2.89	2.70
T_6	2.33	2.37	2.85	2.75

Table 9: Analysis by ANOVA Test

F- Test	S	S	S	S
S. Ed (±)	0.256	0.039	0.033	0.028
C.D. (P=0.05)	0.544	0.084	0.070	0.060

Table 10: Effect of Sensory characteristics during storage of fortified biscuits

Treatments	Colour	Taste	Texture	Flavour	Overall acceptability
T_0	7.58	8.0	7.58	8.0	7.83
T_1	7.66	8.16	7.66	8.16	8.0
T_2	8.0	8.33	8.0	8.33	8.16
T_3	8.0	8.5	8.0	8.5	8.33
T_4	7.33	8.66	7.33	8.66	8.5
T_5	8.67	9.0	8.67	9.0	8.83
T_6	7.86	8.33	7.86	8.33	8.16

Summary and conclusion

Biscuit samples of high nutrition were formulated from wheat flour and Whey Protein Concentrate and curry leaves. The composition and nutritive value of biscuit samples represent balanced quantity of carbohydrate, protein, fat, crude fiber and ash and these samples were acceptable in sensory evaluation. Moisture and ash content of the experimental biscuit samples increased with the level of incorporation of whey protein concentrate and curry leaves while Fat, crude fat and protein content of biscuit sample decreased slightly. The analytical work shows that there was an increase in moisture content in the biscuit sample with increasing the level of WPC and curry leaves powder. But during storage, moisture content of biscuits packed in LDPE increased considerably with increase in storage period as there is some amount of moisture ingress in biscuit samples. Ash increased with increasing the level of WPC and curry leaves powder but decreased during storage period. The % score of Fat, crude fat and protein content decreased with increasing level of WPC and Curry leaves powder. The colour of the biscuits varied due to variation in level of WPC and Curry leaves powder incorporation and chemical changes during storage. The percent score of colour, flavour, taste, and texture was decreased slightly during storage.

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