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Physico-chemical and sensory characteristics of psyllium husk powder and pomegranate juice incorporated digestive cookies

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Abstract
Present research was carried out to utilize psyllium husk for preparation of digestive cookies. Refined wheat flour was replaced with psyllium husk in different combinations @ 5, 10 and 15%. Regarding characterization of psyllium husk, mean values obtained for moisture, crude protein, fat, ash and fiber and in husk were 6.43±0.05, 2.08±0.06, 0.09±0.01, 3.85±0.04, 3.83±0.02 and 70.03±0.02%, respectively. Physical characteristics of digestive cookies i.e. diameter and spread ratio were diminished with the addition of husk while thickness was increased. Chemical assay revealed higher crude protein content in control cookies. Whereas, moisture, ash and fiber contents were higher in psyllium husk based cookies. Softer cookies with low gross energy were obtained with the addition of psyllium husk. Conclusively, psyllium husk based cookies showed gradual enhancement in dietary fiber content as the amount of husk was increased in the recipe. The composition of digestive cookies found nutritionally superior as well as recorded highest score in sensory properties and it can be concluded that the substitution of wheat flour with isabgol up to 15 per cent and 5ml of pomegranate juice into the formulation of cookies enhanced the Physico-chemical properties as well as sensory properties. The resultant cookies may have the potential to manage the digestion and bowel function in human subjects.

Keywords: Psyllium husk, pomegranate juice, digestive cookies, Physico-chemical properties, sensory analysis

Introduction
Dietary components and human health have established links reflecting the pivotal role of nutrients in normal body functioning. Regular consumption of fibre is an important factor to prevent many types of diseases and is associated with a standard balanced diet (Rosell *et al*., 2009) [17]. The positive role of dietary fibre as a prebiotic component is related to their effect in the reduction of chronic diseases including cardiovascular disease, specific types of cancer, and constipation (Beikzadeh *et al*., 2016) [5]. Thus, it is essential to enrich various foods with a variety of dietary fibres.

Psyllium (Plantago ovata) commonly called Isabgol is an annual herb originated from West Asia. It is a source of natural and concentrated soluble fiber derived from the husks of blonde psyllium seed. Husk is the outermost skin of the seed which is removed by a mechanical process. Total recovery of husk is around 25 to 26% from the seed. The psyllium husk contains 6.83% fiber, 0.94% protein, 4.07% ash and 84.98% total carbohydrates (Anjali and Renu, 2015) [3]. Bakery products are prepared from different dosages of psyllium husk and literature suggested that replacement of psyllium husk up to 50% is possible without detrimental change in quality. Other reported that for the enriched cookies (30% psyllium husk powder) and control cookies (100% wheat flour) the total carbohydrates content were 65.7 and 64.9 g, respectively. While the values for starch, sugar and fiber were 30.3, 20.8 and 12.0 g in fiber enriched cookies compared with 40.8, 21.0 and only 1.6 g in control cookies, respectively (Anjali and Renu, 2015) [3]. Psyllium can be used in food and beverages industry as a substitute, thicker and binder such as in health drinks, beverages, ice cream, bread, biscuits, other bakery products, rice, cakes, jams, instant noodles, breakfast cereals etc., in order to improve the fiber content of the food and to increase the bulk of the food with various health benefits. Psyllium Husk may also be added to fresh fruit drinks or flavored drinks to improve the mouth-feel of the drink and make it richer and impart good consistency to it. In food and beverage industry psyllium is use to Improves softness and body texture, to provide strength as binder and stabilizer.

A B

Fig 1: (A). Image of Isabgol (B). Developed cookies

Due to its high water-binding capacity and stability at a variety of pH levels and temperatures, psyllium can be employed as a food additive, improving shelf life and consumer acceptance, and reducing stickiness. Psyllium can be employed as an emulsifier, stabiliser, and substitute for fat and for wheat flour (Zandonadi *et al.* 2010) [27].

Pomegranate (Punica granatum L.) is commercially important fruits that extensively grows in may tropical and subtropical regions of the world (Tehranifar *et al*., 2010) [24],

The antioxidant capacity of pomegranate juice was shown to be three times higher than that of red wine and green tea, based on the evaluation of the free-radical scavenging and iron reducing capacity of the juice. It was also shown to have significantly higher levels of antioxidants in comparison to commonly consumed fruit juices, such as grape, cranberry, grapefruit, or orange juice. Tomás-Barberán (2000) [9], the principal antioxidant polyphenols in pomegranate juice include the ellagitannins and anthocyanins.

Cookies are different from other baked products like bread and cakes because of their low moisture content which ensures less chance of microbial spoilage to provide a longer shelf life, making large scale production and distribution possible (Dhankar, 2013) [8].

Pomegranate juice has shown significant anti atherosclerotic, anti-hypertensive, antioxidant, and anti-inflammatory effects in human subjects and mouse models. The principal mechanisms of action of pomegranate juice may include the following: increased serum antioxidant capacity, decreased plasma lipids and lipid peroxidation, decreased oxidized-LDL uptake by macrophages, decreased intima media thickness, decreased atherosclerotic lesion areas, enhanced biological actions of nitric oxide, decreased inflammation, decreased angiotensin converting enzyme activity, and decreased systolic blood pressure, thereby causing an overall favorable effect on the progression of atherosclerosis and the subsequent potential development of coronary heart disease.

Milk powders contain all twenty-one standard amino acids, the building blocks of proteins, and are high in soluble vitamins and minerals. Powdered milk or dried milk is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it; milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low moisture content. Another purpose is to reduce its bulk for economy of transportation. Powdered milk and dairy products include such items as dry whole milk,non fat (skimmed) dry milk, dry buttermilk, dry whey products and dry dairy blends. (Ramya and Anitha., 2020) [16].

Aims and Objectives

The objectives of this study were

1. To supplement wheat flour (WF) with various levels of psyllium husk (PH) and constant level of pomegranate juice for baking purpose in order to obtain a digestive cookie.
2. To analyze the physico chemical and sensory attributes of digestive cookies

Material and Methods

Procurement of Raw Material

Raw materials such as psyllium husk (Isabgol), pomegranate, refined wheat flour, sugar, fat, baking powder required during present investigation were procured from local market of Hassan. Most of the chemicals and equipment used in this investigation were of analytical grade which are from College of Food Science and Technology, Hassan.

Preparation of pomegranate juice

Preparation of Fresh Pomegranate Juice Fresh uniform and healthy pomegranate fruits (Punica granatum L.) were obtained from local market Hassan. Sweet mature fruits were preferred for the production of concentrate. Fruits were thoroughly washed with tap water to remove surface dirt and macroflora if any. Fruits were surface sterilized with 100 ppm chlorine for 5 min and surface dried. Fruits were manually cut up at equatorial zones. Arils were extracted manually and collected in stainless steel container. From sound arils, juice was mechanically extracted by using hand operated fruit juices. The clarified and filtered dark red coloured juice was used for preparation of pomegranate juice concentrate. (Dhumal *et al.* 2015) [18] The experiment was plan to study the effect of incorporation of different levels of three formulations were prepared by mixing wheat flour and Isabgol in the ratio of 100:0, 90:10 and 85:15 and coded as T_1, T_2 and T_3 respectively and equal quantity (5 ml) of pomegranate juice.

Development and Formulation of psyllium husk and pomegranate juice incorporated cookies

Traditional creaming method was used for the preparation of cookies. Basic recipe used for preparation of cookies. Shortening and sugar were creamed until mixture became light and fluffy. Refined wheat flour was sieved with baking powder. The cream was mixed with flour, psyllium husk and sufficient quantity of pomegranate juice was added to form dough. Then sheet of dough was prepared having thickness of 0.5 cm and manually shaped into circular form (diameter: 60 mm, thickness: 5 mm). The pieces were placed in the baking tray and baked at 180-200 °C for 15 min in an electrically heated baking oven. The cookies were allowed to cooled on wire racks 27 ^{0}C for 30 minutes, packed and stored at ambient temperature (Amit *et al*., 2014) [1] until further analysis. Table 1 shows the basic recipe used for preparation of cookies. According to Anitha *et al.*,2020 [2], Various ratios of wheat flour and pumpkin powder were used to standardize the cookies. Three variations were prepared – T_1 (Standard 100% wheat flour), T_2(wheat flour 90% and pumpkin powder 10%), T_3 (wheat flour 80% and pumpkin powder 20%). Sugar 50g, Fat 50 g, vanilla essence 0.5ml, baking powder 0.5 g, water 30 ml. Wheat flour (Maida), pumpkin powder, baking powder, were sieved together. Finally. Mixing is followed by moulding, in which the dough is laminated into sheets and moulded into required shapes using different moulds.

Table 1: Basic recipe used for preparation of cookies

Ingredients	T_1	T_2	T_2	T_3
Wheat Flour(g)	100	95	90	85
Psyllium husk (g)	0	5	10	15
Pomegranate juice(ml)	0	5	5	5
Fat (g)	50	50	50	50
Sugar powder (g)	50	50	50	50
Milk powder (g)	5	5	5	5
Baking powder (g)	0.5	0.5	0.5	0.5

Note
T_1 Sample =100% wheat flour
T_2 Sample =95% wheat flour and 5% Psyllium husk + 5 ml of pomegranate juice
T_3 Sample = 90% wheat flour and 10% Psyllium husk + 5 ml of pomegranate juice
T_4 Sample = 85% wheat flour and 15% Psyllium husk + 5 ml of pomegranate juice

Physical Properties
The colour of digestive cookies was determined by visual observations, the length, breadth and width of digestive cookies was measured by Vernier calliper. The weight of cookies was measured on analytical weighing balance.

Chemical Properties
Proximate composition such as moisture, ash, crude fat, crude protein and crude fibre of all the Ingredients and digestive cookies was determined according to the procedures given in AOAC (2010). For moisture determination samples were dried in oven at 130 ºC for 60 minutes. For ash determination samples were placed in muffled furnace at 550ºC to burn out all carbon compounds leaving in organic part (ash). Fat was determined by fat extraction unit by using n. Hexane. For fibre determination, samples were treated with 1.25% Sulphuric acid and Sodium Hydroxide solution. After filtration of digested material, it was washed with hot water and then ignited. By calculating loss of weight after ignition, crude fiber contents were determined. Protein contents were determined by using Kjeldahls unit.
We were calculate the carbohydrates and calorific value by using following formula. Carbohydrate (%) Carbohydrate content was calculated by differential method. Carbohydrate (g/100 g) =100–[Protein (%) + Fat (%) +Ash (%) + fibre (%) + Moisture (%)].
Calorific value (Kcal /100 g) Energy was calculated by differential method. Energy (K.cal) = [Protein (g) x 4 + Fat (g) x 9 + Carbohydrates (g) x 4]

Sensory Evaluation
Sensory evaluation of digestive cookies was carried out by a semi trained panel consisting of Teachers and Under-Graduate students of College of Agriculture, Hassan with the help of nine point hedonic rating scale (1 = dislike extremely, 2 = like only slightly, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely). Sensory evaluation of cookies for various attributes like color, flavor, taste, texture and overall acceptability was carried out. Meilgaard *et al.* (2007) [13].

Statistical Analysis
Statistical Analysis was done using computer software. The analysis was done by application of ANOVA at 5% significance level.

Results and Discussion
Proximate analysis
Proximate analysis of ingredients used in digestive cookies as shown in Table 2.

Table 2: Nutritional Composition of Wheat flour, Isbagol, Pomegranate juice, milk powder was analysed using AOAC methods

Ingredients	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Carbohydrates (g)	Energy Kcal)
Wheat flour	13.3±0.28	11.00±0.42	0.9±0.02	0.60±0.23	0.30±0.33	73.90±0.47	348.00±0.78
Isabgol	6.43±0.05	2.08±0.06	0.09±0.01	3.85±0.04	70.03±0.02	17.55±0.52	79.33±0.42
Pomegranate juice	92.00±0.02	0.20±0.01	0.01±0.00	0.30±0.02	0.10±0.01	7.39±0.45	30.45±0.05
Milk powder	3.50 ±0.22	25.8±0.41	26.7±0.78	6.0±0.41	-	38.00±0.44	496.00±0.21

Proximate analysis of ingredients used in digestive cookies as shown in Table I. It is evident from the result That isabgol contains moisture (6.43%), protein (2.08%),ash (3.85%),fat (0.09%), fiber (70.03%),carbohydrates (17.55%) respectively. Qaisrani *et al*., 2014 [15], result reveled that, the chemical properties of Psyllium husk were carried out which shows moisture content (6.76%), Fat (0.12%), Ash (4.05%), Protein (2.3%) and Fibre (70.63%). There is evident that dietary fiber has a number of beneficial effects related to its indigestibility in the small intestine. (Anitha *et al.*, 2015).
Characterization of psyllium husk Compositional estimation of the supplement (husk) is important because addition of husk in cookies may play a mandatory role in the adjustment of physical and chemical characteristics. Chemical analysis is also important to assess the efficacy of the supplement. Thus, husk was examined for its constituents including moisture, ash, protein, crude fat, crude fiber and nitrogen free extract (NFE) along with dietary fiber especially the arabinoxylan content, the physiologically active component against different ailments (Qaisrani., *et al* 2014) [15].
Pomegranate juice contains moisture (92.00%). protein (0.2%), fat (0.01%), ash (0.30%), fiber (0.10%), carbohydrates (7.39%) and energy (30.45 kcal).
Milk powder contains moisture (3.5%), protein (25.8%), fat (26.7%), ash (6.0%), carbohydrates (38%) and energy (496 kcal).

Sensory Analysis

Table 3: Mean scores for the sensory evaluation of cookies samples

Quality Parameters	T_1	T_2	T_3	T_4
Colour	8.58±0.21	8.95±0.11	8.52±0.41	8.01±0.52
Aroma	8.08±0.02	8.32±0.24	8.25±0.48	8.20±0.42
Taste	8.05±0.54	9.00±0.01	8.57±0.58	8.45±0.22
Texture	7.51±0.50	7.82±0.55	7.95±0.23	8.04±0.34
Overall acceptability	7.20±0.22	8.55±0.41	8.45±0.05	8.38±0.11

The mean scores for sensory evaluation of T_1 (control), T_2, T_3 and T_4, samples are shown in Table 3. Mean squares explicated that significant effect on the sensory atributes like colour, aroma, taste, texture and overall acceptability at different formulation of digestive cookies.

Colour: For control sample, scores assigned for colour were 8.58±0.21 whereas in cookies containing psyllium husk and pomegranate juice means ranged from 8.01±0.52 to 8.95±0.11 in T_4 and T_2, respectively (Table 3).
Colour is significantly affected by the addition of psyllium husk however, replacement up to 20% is quite acceptable in cookies. (Tahira Batool Qaisrani, *et,al,* 2013) [23]. The results are supported by the earlier work of Sharif *et al*. (2009) [20], they observed significant effect of fiber on color of the cookies. Likewise, fiber addition exerted momentous effect on color is also reported by Pasha *et al*. (2011) [14].

Aroma: Scores for aroma elucidated that husk and pomegranate juice addition in dietetic cookies imparted positive effect (Table 3). Means for T_1 were 8.08±0.02 compared to T_2 as 8.32±0.24 whereas, scores for T_3 and T_4 were 8.25±0.48, 8.20±0.42,respectively thus behaved non significantly. This studies was on par with result of Tahira Batool Qaisrani, *et al,* 2013 [23].
Flavor is the perception influenced by taste and smell impression even the appearance and texture may also affect this attribute (Manley, 2002) [12]. Treatments showing significant effect on flavor might be due to psyllium husk supplementation in the cookies as imparts its own hedonic acuity.

Taste: Regarding taste, formulated cookies showed varied response (Table 3). The highest scores were assigned to T_2 and T_3 i.e. 9.00±0.01 and 8.57±0.58, respectively as compared to 8.05±0.54 in control (T_1). Taste is also affected by texture and composition of the product and in the present case cookies rheology and composition were altered due to husk addition. The finding were on par with result reported by Tahira Batool Qaisrani, *et al,* 2013 [23]. It is interesting to mention that 20% replacement of flour with psyllium husk had better taste and acceptability Sharif *et al*. (2009) [20].

Texture: Results of the texture on digestive cookies are presented in table 3. T_4 sample highest score of 8.04±0.34 followed by T_3 (7.95±0.23), T_2 (7.82±0.55) compared to control (7.51±0.520).For texture, the highest scores 7.46±0.10 were observed in T_3 followed by 7.18±0.08, 6.45±0.12 6.21±0.16 and 6.07±0.18 in T_4, T_2, T_1 and T_5, respectively while the lowest scores 6.05±0.24 (Tahira Batool Qaisrani, *et al.* 2013) [23].
Psyllium husk addition showed suitability up to 20% afterwards a sudden decline in texture was observed. It has already been proved that increased moisture has inverse association with texture thus decreased scores.

Overall acceptability: Treatments exerted significant effect on the overall acceptability of cookies. The highest scores were attained by T_2 as 8.55±0.41 that followed by with T_3 (8.45±0.05), T_4 (8.38±0.11) compare to T_1(7.20±0.22). Considering the results of sensory view point, it is concluded that psyllium husk addition up to 15% in cookies is quite acceptable, providing sufficient amount of dietary fiber and has potential to be used as dietary intervention against life-style related disorders.

Physical properties of digestive cookies
It is important for the manufacturer as well as for consumers that product should be of acceptable quality in the first look. The control and Isabgol supplemented cookies were evaluated for physical characteristics like weight, diameter, thickness and spread ratio.

Table 4: Formulation effects on physical characteristics of isabgol and pomegranate incorporated digestive cookies

Parameter	T_1	T_2	T_3	T_4
Weight (g)	22.08±0.22	21.95±0.42	21.69±0.52	21.01±0.21
Diameter (cm)	4.12±0.12	4.03±0.24	3.93±0.32	3.51±0.15
Thickness (cm)	0.92±0.20	1.02±0.12	1.20±0.33	1.38±0.41
Spread ratio	4.48±0.11	3.95±0.23	3.28±0.42	2.54±0.34

Weight
It can be observed from Table 4 that weight of the cookies varies due to formulation effects and decreasing trend in the weight of cookies were found with the increase in level of psyllium husk incorporation level @ 5,10 & 15% respectively for T2, T3 and T4 compared to control. Weight of the cookies was highest in case of control T1(22.08±0.22) sample without psyllium husk.Similar results were reported by Syed *et al*., 2018 [21], weight of the cookies varies due to treatment effects and increasing trend in the weight of cookies were found with the increase in level of psyllium husk incorporation level @ 6,9 & 12% respectively for both native and modified Psyllium husk The significant effect of treatment on weight of cookies may be due to addition of fiber that alters dough rheology and allied characteristics in baked products (Hussain *et al*. 2006) [10].

Diameter
Means for the effect of formulations on the diameter of the cookies presented a decreasing trend presented in Table 4. The maximum diameter 4.12±0.12cm and minimum value 3.51±0.15cm was observed and recorded in T_1 (Control) and T_4 (containing 15% Isabgol) respectively. This remarkable effect in formulations on the diameter of cookies may be due to the addition of fiber that alters dough rheology and allied characteristics in a baked product as well fiber addition leading to the deterioration due to the potential of fiber to absorb moisture from the surroundings. The diameter of control cookies (T0) was 44.94±0.08mm that decreased with increase of psyllium husk and minimum value 40.86±0.08mm was recorded in cookies containing 25% psyllium husk (T5). Qaisrani, *et al*, 2014 [15], They also found decreasing trend in cookies diameter due to addition of fiber content (Hussain *et al.* 2006) [10].

Thickness
Thickness increased gradually due to increase in the incorporation level of psyllium husk with as indicated in Table 4. Means for thickness were estimated as 0.92±0.20cm in control cookies whereas maximum value 1.38±0.41cm in

T_4. According to Tahira Batool Qaisrani *et al*, 2014 [24]. The variation in thickness within treatments is that flour was replaced with husk thereby decreased starch and protein contents resulting gradual condensation of dough that consequently increased thickness. Similar result was observed in Devika Tripathi and Ritesh Kumar Tiwari, 2019 [7], Increment in thickness in formulations had been observed with increasing level of Isabgol as 10.23±0.06 mm in control cookies whereas maximum value 11.01±0.08 mm.

Spread Ratio

Means for spread ratio in Table 4 indicating diminution trend due to formulated cookies as values ranged from 4.48±0.11 to 2.54±0.34 in T_1 to T_4, respectively. Highly significant results in spread ratio due to treatments and storage are function of variations in diameter and thickness. Previous studies of Hussain *et al*. (2006) [10] and Sharif *et al*. (2009) [20] strengthened the current results as they reported significant effect of fiber addition on spread ratio of cookies. They further elucidated that spread ratio decreased as function of fiber and the possible reason may be the absorption of moisture that increased the diameter and accordingly affected spread ratio. According to Ranjitha *et al*, 2018 [11], the results pertaining to spread ratio of pomegranate peel powder and soybean flour fortified cookies showed no significant differences among the treatments. However, the spread ratio decreased due to different levels of pomegranate peel powder and defatted soybean flour with refined wheat flour. Reverse trend was observed for the cookies incorporated with acid modified psyllium for the treatments M1 & M2 with recorded values of 5.00 & 4.65 for spread ratio more than control cookies (4.63). Spread ratio of M1 & M2 treatments increased as their diameter too found decreasing, due to reduction in moisture absorption capacity of the psyllium husk because of acid modification resulting in less absorption of moisture by the cookies that decreased the diameter and accordingly affected spread ratio. Moreover, the reverse trend was not found for M3 treatment with 12% incorporation level of acid modified PSH in cookies, recorded 3.43 spread ratio value less than control. (Syed *et al*, 2018) [21].

Proximate composition

Table 5: Proximate Composition of Digestive Cookies by Incorporation of Psyllium Husk and Pomegranate Juice

Parameters	T_1	T_2	T_3	T_4
Moisture (%)	3.45±0.30	3.60±0.22	3.62±0.09	3.65±0.05
Fat (%)	18.01±0.02	17.89±0.44	17.83±0.14	17.74±0.55
Fibre (%)	3.80±0.22	5.21±0.08	7.12±0.51	9.12±0.88
Ash (%)	1.17±0.11	1.28±0.23	1.59±0.32	1.82±0.44
Protein (%)	8.50±0.08	8.24±0.24	8.01±0.25	7.52±0.12
Carbohydrates (%)	65.07±0.12	63.78±0.22	61.83±0.58	60.15±0.51

Moisture

Means for moisture in different formulations from 3.45±0.30 to 3.65±0.05% showing a progressive increase in moisture level with the addition of Isabgol in cookies. Increase in the moisture of cookies was due to increased Isabgol level that has a tendency to absorb water because of the hydrophilic nature of Isabgol that increased moisture percentage in cookies during the preparation process.

The present results are in confirmatory with the outcomes of Uysal *et al* 2007 [25]. who reported significant effect on moisture by addition of fiber in oven-baked cookies. They concluded that in cookies, fiber improves the water holding capacity as compared to wheat flour resultantly increasing moisture level.

Crude fat

Formulations showed a slightly decreasing pattern on the fat percentage of cookies. The maximum mean value was recorded as 18.01±0.02% in control that reduced up to 17.74±0.55%. Formulations exerted a slight reduction in fat percentage might be due to increased fiber and moisture contents. (Qaisrani *et al*, 2014) [15] (Uysal *et al* 2007) [25].

Crude fiber

Minimum crude fiber was observed as 3.80±0.22 (Control) by adding of Isabgol it increased to 9.12±0.88% in cookies T_4. Enhanced dietary fiber in different treatments owes to supplementation of cookies with psyllium husk containing high fiber contents. Similar results are assessed by other researchers that incorporation of fiber enriched sources boost the dietary fiber in resultant bakery products. The current results are supported by the work of Vega-Lopez *et al.* (2001) [26] indicating significant increase for this trait in cookies supplemented with fiber.

Ash

Total ash increased gradually in the treatments from control (T_1) to cookies containing 15% psyllium husk (T_4) as depicted in Table 5. Means for ash in T_1 was 1.17±0.11% compared to 1.82±0.44% in T_4 indicating increase in ash percentage with incremental increase in psyllium husk. The momentous increase of ash in various treatments is attributed to increased psyllium husk level as fiber provides sufficient amount of ash to the recipe, being a compositional constituent. Findings of Hussein *et al*. (2011) delineated a similar increasing trend in ash content due to fiber addition. Furthermore, Pasha *et al.* (2011) [14] also reported increased mineral profile in the baked products attributed to high ash content of the composite flour.

Crude protein

Decreasing pattern in protein content was observed by the addition of Isabgol among different formulations of cookies. Highest mean value 8.50±0.08 was reported in control that reduced to 7.52±0.12 in cookies containing 15% Isabgol (T_4). The reason for this was the Wheat flour included as the main source of protein and the replacement of flour with Isabgol resulted from a decrease in protein content. Another reason for the reduction in protein content may be owing to an increased moisture content of the cookies that changed the overall chemistry of the end product. Possible complex formation between husk and protein moiety may also be a factor for reduced estimation of protein. Bilgicli *et al.* (2007) [6].

Carbohydrates

Minimum carbohydrates was observed as 65.07±0.12 (Control) by adding of Isabgol it decreased to 60.15±0.51% in cookies T_4. The reason for this was the Wheat flour included as the main source of carbohydrates and the replacement of flour with increasing Isabgol resulted from a decrease in carbohydrate content.

Conclusion

The composition of digestive cookies found nutritionally superior as well as recorded highest score in sensory properties and it can be concluded that the substitution of wheat flour with isabgol up to 15 per cent and 5ml of

pomegranate juice into the formulation of cookies enhanced the Physico-chemical properties as well as sensory properties. The preparation of digestive cookies enriched with Isabgol and pomegranate juice can be considered as an alternative way to include this health promoter fiber in human nutrition. Dietary fibers from Isabgol have been used extensively as pharmacological supplements, food ingredients and in processed food. It can be concluded that the Isabgol possesses the dual potential in pharmaceuticals. Initially, its use was limited as a natural drug but due to its high fiber content, it was utilized as neutraceuticals food products as in digestive cookies for improving and boosting digestive process as well as improving bowel function. Softer cookies with low gross energy were obtained with the addition of Isabgol. Isabgol based cookies showed gradual enhancement in dietary fiber content as the amount of husk was increased in the formulation. The resultant cookies may have the potential to manage the digestion and bowel function in human subjects.

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