International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Psyllium (*Plantago ovata*) Husk: A Wonder Food for Good Health

Anjali Verma[1], Renu Mogra[2]

[1]Research Scholar, Department of Foods & Nutrition, College of Home Science, MPUAT, Udaipur, Rajasthan.

[2]Professor and Head, Department of Foods & Nutrition, College of Home Science, MPUAT, Udaipur, Rajasthan.

Abstract: ***The aim of the study was to explore the health promoting effects of psyllium husk and its successful applications in food industries. Psyllium Husk (Isabgol) has been popularly used as therapeutic agent. Dietary fibers from psyllium husk have been used extensively both as pharmacological supplements and food ingredients and in processed food. Several papers were reviewed to find out psyllium husk role in the prevention and treatment of chronic diseases. People are unaware of its benefits in treatment of diabetes, weight loss, obesity, high blood pressure, constipation, diarrhea and hypercholesterolemia, heart disease. Though much researches have been conducted to investigate the health promoting effects of psyllium husk, a very few studies have been done on developing food products fortified with psyllium.***

Keywords: Psyllium Husk**,** pharmacological supplements, food ingredients, chronic diseases, fortified

1. Introduction

Psyllium was introduced as a medicinal plant by Indian Muslims and seeds were firstly collected from some wild species. In Pakistan, it was firstly cultivated in Lahore and Multan districts and then moved to Bengal, Mysore and Indian Coromandel coast. Psyllium was a native of Persia, now grown in the western part of India. The term “Psyllium” is used for the crust, seed and the whole plant. It is considered as a good source for soluble and insoluble fiber. Its soluble content is almost eight times more than that of oat’s bran. The diet fibers extracted from the plant possess pharmaceutical properties and can be used in producing low calorie food (Theuissen 2008).

The world market is dominated by India in the production and export of psyllium. The crop is mainly cultivated in Gujarat, Madhya Pradesh and Rajasthan. In India Gujarat and Rajasthan states are the major producer states of psyllium because the climatic conditions of them are most suitable for the psyllium cultivation; and both the states contribute almost equally in terms of production, but regarding further processing and manufacturing of husk, Gujarat is the leading state contributing 35% of world production of Psyllium Husk.

Psyllium or Ispaghula is the common name used for several members of the plant genus *Plantago* whose seeds are used commercially for the production of mucilage. Seed produced from *P. ovata* is known in trading circles as white or blonde psyllium, Indian plantago, or Isabgol. Isabgol, (or Ispaghol in Pakistan) the common name in India for *P. ovata*, comes from the Sanskrit words *asp* and *ghol*, meaning "horse flower," which is descriptive of the shape of the seed. Psyllium is a source of natural and concentrated soluble fiber derived from the husks of blonde psyllium seed. Psyllium husk is the main product of Isabgul. Husk is the outermost skin of the seed which is removed by mechanical process. Total recovery of husk is around 25 to 26 % from the seed. Psyllium husk’s shelf life remains only 6 months in ordinary and traditional storage conditions. The husk is about 10-25% of seed on dry weight basis. *P. ovata* is a 119- to 130-day crop that responds well to cool, dry weather. In India, *P. ovata* is cultivated mainly in North Gujarat as a "Rabi" or post–rainy season crop (October to March). During this season, which follows the monsoons, average temperatures are in the range of 15–30 °C (59–86 °F), and moisture is deficient.

2. Nutritional Quality

The psyllium husk contains 6.83%, 0.94% protein, 4.07% ash and 84.98% of total carbohydrates (Guo *et al.*, 2008; Yu *et al*., 2009). Osborne fractionation (based on solubility) yielded albumin 35.8%, globulin 23.9%, and prolamin 11.7%. The oil from plantago seeds had a high percentage of linoleic acid (40.6%) and oleic acid (39.1%) and a minor proportion of linolenic acid (6.9%).

Rat bioassays showed values of 89.6% digestibility of dry matter, 86.0% apparent digestibility, 88.1% true digestibility, and 4.40 net protein ratio corrected (NPRc.). The importance of these findings is that plantago whole grain shows favorable nutritional quality when compared with cereals and legumes (Romero-Baranzini *et al.* 2006). The hydrogel produced by Isabgol (plantago ovata forskal) is rigid, difficult to brake, to dissolve (Majmudar *et al.* 2002). Hydrophobicity of the psyllium seed hydrocolloidand found that all the solutions showed non Newtonian shear thinning behaviour in different concentrations and pH. The viscosity of the psyllium crust solution is temperature, pH, concentration and shear rate dependent (Farahnaki *et al*. 2010).

Fibers, particular viscous dietary fibers, have positive effects on human health, both in the prevention and in treatment of chronic diseases (Singh 2007). Psyllium is produced mainly for its mucilage content. *Mucilage* describes a group of clear, colourless, gelling agents derived from plants. The mucilage obtained from psyllium comes from the seed coat. Mucilage is obtained by mechanical milling/grinding of the outer layer of the seed. Mucilage yield amounts to about

25% (by weight) of the total seed yield. Plantago-seed mucilage is often referred to as husk, or psyllium husk. The milled seed mucilage is a white fibrous material that is hydrophilic, meaning that its molecular structure causes it to attract and bind to water. Upon absorbing water, the clear, colourless, mucilaginous gel that forms increases in volume by tenfold or more.

A factor in physiological fibre behavior of psyllium gum is its high viscosity and gel-like character in water (Al-Assaf *et al.* 2003). Psyllium mucilage possesses several other desirable properties. As a thickener, it has been used in ice cream and frozen desserts. A 1.5% weight/volume ratio of psyllium mucilage exhibits binding properties that are superior to a 10% weight/volume ratio of starch mucilage. The viscosity of psyllium mucilage dispersions are relatively unaffected between temperatures of 20 and 50 °C (68 and 122 °F), by pH from 2 to 10 and by salt (sodium chloride) concentrations up to 0.15 M. These physical properties, along with its status as a natural dietary fiber, may lead to increased use of psyllium by the food-processing industry. Technical-grade psyllium has been used as a hydrocolloidal agent to improve water retention for newly seeded grass areas, and to improve transplanting success with woody plants. Psyllium mucilage is also used as a natural dietary fiber for animals. The dehusked seed that remains after the seed coat is milled off is rich in starch and fatty acids and is used in India as chicken feed and as cattle feed.

Psyllium husk also contains a high proportion of hemicellulose, composed of a xylan backbone linked with arabinose, rhamnose, and galacturonic acid units (arabinoxylans). The seed consists of 35-percent soluble and 65-percent insoluble polysaccharides (cellulose, hemicellulose, and lignin). Psyllium hydrophilic mucilloid, is a natural fiber derived from psyllium seed husks. It is a highly branched arabinoxylan polysaccharide which has a high water holding and gelling capacity. Gel-forming fraction of the alkali extractable polysaccharides of psyllium is composed of arabinose, xylose and traces of other sugars (Fischer *et al.* 2004).

3. Application of Psyllium Husk or Powder in Food industries and its Benefits

Research indicates that husk is quite safe to use in functional and nutraceutical foods. The FDA has approved the use of food products containing psyllium husk due to its associated health claims (Leeds 2009). Supplementation of fiber, are appreciated by the consumers due to appealing taste and better storage stability. Seeds of psyllium have been used for hundreds of years in traditional Iranian medicinal prescriptions. Because of its pharmacological effects, foods fortified with *Plantago ovata* mucilage gum may have a superior consumer acceptance. It is commonly found in consumer products such as high fiber breakfast cereals. In addition to being part of fiber formulations, psyllium supplements can also be found in granule, powder, wafer, and capsule forms. And importantly, because psyllium contains an increased amount of soluble fiber gram for gram compared to sources such as oat bran, its use may help fulfill daily dietary fiber recommendations more easily.

The effect of soluble fiber from psyllium on body lipids and proteins associated with metabolic process. The functional and nutraceutical foods containing fiber are being developed and studied for their effectiveness with special reference to bakery products, yogurt and drinks (Martin *et al.* 2008; Perrigue *et al.* 2009). Bakery products are prepared from different dosage of psyllium husk and literature suggested that replacement of psyllium husk up to 50% is possible without detrimental change in quality. And also explained the hypocholesterolemic worth of psyllium considering gender and hormonal status in men and pre and postmenopausal women. In postmenopausal women, administrated psyllium (15g/day) for six weeks significantly lowered the total cholesterol concentration (5.2%) whereas, in premenopausal women (1.3%) whilst, no significant differences observed in triglycerides, apolipoprotein A1 and apolipoprotein B concentration in pre and postmenopausal women. They concluded that postmenopausal women can be benefitted from addition of psyllium husk in their diet for reducing coronary risk (Ganji and Kuo 2008). In other study it was investigated that analyses for fiber added cookies (30% psylluim husk powder) and control (wheat flour) presented the values for carbohydrates as 65.7 and 64.9g, respectively. While the values for starch, sugar and fiber were 30.3, 20.8 and 12.0g in fiber cookies compared with 40.8, 21.0 and only 1.6g in control, respectively. There was a marked difference in soluble fiber content as only 0.9g in control versus 9.3g in psyllium enriched cookies. The protein and fat contents measured were 5.9 and 20.6g compared with 4.8 and 20.5g in control and psyllium products, respectively while total energy calculated in kJ was 1996 and 1803 in control and fiber cookies, respectively (Vega-Lopez *et al.* 2001). In processed food to aid weight control, regulation of glucose level for diabetic patients and reducing serum lipid levels in hyperlipidemics due to polysaccharide and its gel-forming nature (Singh 2007). Bioactive profile of different fiber sources is also important like arabinoxylan (AX) that not only improving the quality of baked products but also has pronounced therapeutic potential. Modified samples of the bread dough with psyllium achieved a 93.0% acceptance rate for individuals with celiac disease and up to 97.0% for individuals without celiac disease. In terms of chemical composition of the bread dough products had 42.3% less fat and, consequently, 32.1% fewer calories. So, psyllium can replace gluten in preparations. Furthermore, in terms of chemical composition, products made with modified dough had less fat and fewer calories (Zandonadi *et al.* 2009). The effects of psyllium fiber addition to wheat flour at the levels of 0, 1, 2, 3 and 4% on the rheological behavior of the dough. Upon the addition of psyllium fiber, a significant increase in Farinograph (rheological device) water absorption, simultaneously with the increase of the addition level, was recorded. Psyllium fiber added in wheat flour up to 4% increased the falling number (FN) index. It clearly indicates that incorporating psyllium fiber in wheat flour dough leads to an increase of water absorption. Regarding the falling number index, psyllium fiber addition leads to a decrease of α-amylase activity. Therefore, using psyllium fiber at an optimal level, allows an increase of the daily intake of fiber without promoting negative effects on the rheological properties of the dough (Mironeasa *et al.* 2013). In a studied the development of “Spongy Dessert” by incorporating the

"mucilage" powder extracted from the seeds of psyllium (*Plantago ovata*). The mucilage powder was incorporated at 3.0, 3.5 4.0 & 4.5 % level in the Chhena (milk solid) prepared from the low fat cow milk. On the basis of results obtained through organoleptic evaluation, the Spongy Dessert prepared by incorporating 4% mucilage was selected and analyzed for nutrients. The developed product namely herbal rassogolla prepared by incorporating 4.0 % mucilage powder was a good source of protein (13.8 g/100g) and dietary fibre (1.5), low in carbohydrates (18.8 g/100g), saturated fat (0.8 g/100g) & energy (141.2 Kcal) and free from trans fat. This mucilaginous spongy dessert has the properties to provide relief from constipation and acidity (Garg *et al.* 2014).

Gums and Mucilage are naturally occurring biopolymers, finding increasing applications in pharmaceutical and biotechnology industry. It has been used successfully for many years in the food and pharmaceutical industry as a thickening agent, as a gelling agent, and as a colloidal stabilizer. Mucilage also has several unique properties that have enabled it to be used as a matrix for entrapment and/or delivery of variety of drugs, proteins, and cells. Being a naturally occurring polysaccharide, in recent year it has gained increased importance in industrial applications (Majmudar *et al.* 2002).

4. Therapeutic Application

Isabgol has been popularly used as therapeutic agent for the treatment of constipation, diarrhea, irritable syndrome, inflammatory bowel disease, ulcerative colitis, colon cancer, diabetes, and hypercholesterolemia. Psyllium husk is considered as mild and natural laxative thereby facilitates digestion. It becomes gelatinous and sticky when soaked in water and absorbs water to perform characteristic functioning. It is assumed that dietary fiber from psyllium husk may help in weight management and fat loss by acting as bulking agent. In this context, considerable factors are increasing satiety, reducing caloric intake, ingestion rate and nutrient absorption (Cummings *et al.* 2004). It improves glucose homeostasis and lipid & lipoprotein profile in obese and hypercholesterolemic subjects (Moreno *et al.* 2003). Isabgol (Psyllium) husk, a natural edible polymer has been reported to be used in hemorrhoids, constipation, diabetes, ulcerative colitis. Besides its traditional use in constipation, husk can lower down the abnormal LDL level up to the normal which is the causative factor for different problems eg. Hypercholesterolemia, hypertension, low body working efficiency etc. Also, it has shown its cancer protective effect in different studies. All of the therapeutic applications of Isabgol husk are with negligible side effects/ or adverse effects. But the benefits in certain cases as on reducing the glucose level are still controversial and has not been totally studied or appropriately shown in type II diabetes. Therefore, firmly speaking it is not only a laxative agent but also a true soluble dietary fiber source with hypocholesterolemic and hypoglycemic perspectives (Singh 2007; Yu *et al.* 2009; Vyth *et al.* 2010). Psyllium fiber supplements alone or with healthy diet significantly reduced body weight, percent total body fat and BMI. Moreover, it has significant role in lowering triglycerides and insulin level as compared to control after 12 weeks of psyllium consumption. However, diet enriched with fiber significantly reduced total cholesterol and LDL thereby ultimately declines metabolic syndrome risk factors (Pal *et al.* 2011).

Different cereal and vegetable based soluble and insoluble fibers are in use to overcome the menace of high cholesterol and glycemic disorders. The foremost fiber sources are psyllium husk, oat, guar gum and some other cereals. However, psyllium husk fiber appears one of the effective sources with least adverse effects (Galisteoa *et al.* 2010). It has high water soluble fiber that soothes the lipid and glycemic response in individuals with hypercholesterolemia. Psyllium husk owing to presence of neutral and acid polysaccharides containing galacturonic acid with an appropriate ratio of soluble/insoluble fiber has anti-obesity properties. Different investigations indicated that psyllium husk supplementation results in reduction of postprandial glucose level ranging from 12.2 to 20.2% in diabetic patients. In hypercholesterolemic children, psyllium lowers serum LDL and triglycerides concentration up to 22.81 and 19.54%, respectively whilst increases HDL up to 3.05% (Moreno *et al.* 2003). Some of the impacts as laxative can be due to its bioactive components, namely phenolic compounds such as acetoside and isoacetoside. Antidotal and antioxidant activities besides being painkillers are among their biological functions (Li *et al.* 2005). The so called properties have made psyllium a suitable functional dietetic fiber to use in some food products. It can be used as a bioactive oligosaccharide with probiotic properties (Askari *et al.* 2008). Psyllium is well accepted as a safe and effective bulk laxative and is an adjunct to dietary intervention for individuals who do not adequately respond to a low-fat, low-cholesterol diet.

5. Conclusion

The utilization of psyllium husk is limited to treat constipation, diarrhea and hypercholesterolemia. People are unaware of its benefits in treatment of diabetes, weight loss, obesity, high blood pressure and heart disease. Though much researches have been conducted to investigate the health promoting effects of psyllium husk, a very few studies have been done on developing food products fortified with psyllium. Therefore there is a need to elaborate health benefits of psyllium husk interms of its nutritional quality to emanate the public health disorders and make food products at household level.

References

[1] Al-Assaf, S., Phillips, G.O., Williams, P.A., Takigami, S., Dettmar, P. and Havler, M. Molecular weight, tertiary structure, water binding and colon behaviour of ispaghula husk fibre. Proceedings of the Nutrition Society. **62:** 211–21(2003).

[2] Askari, H., Farahnaki, A., Majzoobi, M. and Mesbahi, G.H. Hydrocolloid extraction from Psyllium husk and investigation on its rheological properties. 18th, National Iranian food science and technology conference.

[3] Cummings, J.H., Edmond, L.M. and Magee, E.A. 2004. Dietary carbohydrates and health: Do we still need the fiber concept? *Clinc. Nutr. Suppl.* **1**:5-17 (2008).
[4] Farahnaki, A., Askari, H., Majzoobi, M. and Mesbahi, G.H. The impact of concentration, temperature and pH on dynamic rheology of Psyllium gels. *J. of Food Engineering*.1-8 (2010).
[5] Fischer, H.M., Nanxiong, Y., Ralph, R.G.J., Andersond, L. and Marletta, J.A. The gelforming polysaccharide of psyllium husk (Plantago ovata Forsk). *Carbohydrate Research.* **339**:2009–2017 (2004).
[6] Ganji, V. and Kuo, J. Serum lipid responses to psyllium fiber: differences between pre- and post-menopausal, hypercholesterolemic women. *Nutrition Journal* , **7**:22 doi:10.1186/1475-2891-7-22 (2008).
[7] Garg, P., Raghav, P.K., Sharma, R.K., Jasuja, N.D., Sharma, R., and Agarwal, N. Development of Mucilaginous Spongy Dessert-A Herbal Rassogolla Prepared from Cow Milk. *International J. of Scientific and Research Publications.* **4**(2) ISSN 2250-3153(2014).
[8] Galisteoa, M., Morona, R., Riveraa, L., Romeroa, R., Anguerab, A. and Zarzueloa, A. *Plantago ovata* husks-supplemented diet ameliorates metabolic alterations in obese Zucker rats through activation of AMP-activated protein kinase. Comparative study with other dietary fibers. *Clin. Nutri.* **29**:261-267 (2010).
[9] Guo, Q., Cui, S.W., Wang, Q. and Young, J.C. Fractionation and physicochemical characterization of psyllium gum. *Carbohyd. Polym.* **73**:35-43 (2008).
[10] Leeds, A.R. Dietary Fiber; Role in Nutrition Management of Disease. In: Guide to Nutritional Supplements. Caballero, B. (ed.). Academic press, USA (2009).
[11] Li, L., Tsao, R., liu, S., Yang, J. C., Zhu, H., deng, Z., Xie, M. and Fu, Z. Isolation and purification of acetoside and isoacetoside from Plantago Psyllium L. by high speed counter current chromatography. *J. of Chromatography.* **1063**:161-169 (2005).
[12] Majmudar, H.; Mourya, V.; Devdhe, S. and Chandak, R. Pharmaceutical Applications of Ispaghula Husk: Mucilage. *International J. of Pharmaceutical Sciences Review & Research.* **18**(1):49-55 (2002).
[13] Martin-Diana, A.B., Rico, D. and Barry-Ryan, C. Green tea extract as a natural antioxidant to extend the shelf-life of fresh-cut Lettuce. *Innovative Food Sci. Emerging Technol.* **9**:593-603 (2008).
[14] Mironeasa, S., Codină, G.G. and Popa, C. Effect of the addition of Psyllium fiber on wheat flour dough rheological properties. *Recent Researches in Medicine, Biology and Bioscience.* ISBN: 978-960-474-326-1 (2013).
[15] Moreno, L.A., Tresaco, B., Bueno, G., Fleta, J., Rodriguez, G., Garagorri, J.M. and Bueno, M. Psyllium fiber and the metabolic control of obese children and adolescents. *J. Physiol. Biochem.* **59**:235-242 (2003).
[16] Pal, S., Khossousi, A., Binns, C., Dhaliwal, S. and Radavelli-Bagatini, S. The effects of 12-week psyllium fiber supplementation or healthy diet on blood pressure and arterial stiffness in overweight and obese individuals. *Br. J. Nutr.* **26**:1-10 (2011).
[17] Perrigue, M.M., Monsivais, P. and Drewnowski, A. Added soluble fiber enhances the satiating power of low-energy-density liquid yogurts. *J. Am. Diet. Assoc.* **109**:1862-1868 (2009).
[18] Romero-Baranzini, A. L , Rodriguez, O. G., Yanez-Farias, G. A., Barron-Hoyos, J. M. and Rayas-Duarte, P.. Chemical, Physicochemical, and Nutritional Evaluation of Plantago (*Plantago ovata* Forsk). *Cereal chem. J.* **83**(4): 358-362 (2006.
[19] Singh, B. Psyllium as therapeutic and drug delivery agent. *Int. J. Pharmaceutics.* **334**: 1-14 (2007).
[20] Theuissen, E. A. M. Water soluble dietary fibers and cardiovascular disease. *Physiology and Behavior*. **94**: 285-292 (2008).
[21] Van-Craeyveld, V.V., Delcour, J.A. and Courtin, C.M. Extractability and chemical and enzymic degradation of psyllium (Plantago ovata Forsk) seed husk arabinoxylans. *Food Chem.* **112**:812-819 (2009).
[22] Vega-Lopez, S., Vidal-Quintanar, R.L. and Fernandez, M.L. Sex and hormonal status influence plasma lipid responses to psyllium. Am. *J. Clin. Nutr.* **74**:435–441 (2001).
[23] Vyth, E.L., Steenhuis, I.H.M., Roodenberg, A.J.C., Brug, J. and Seidell, J.C. Front-of-pack nutrition label stimulates healthier product development; a quantitative analysis. *Intl. J. Behavioral Nutr. Physical Activity.* **7**:65 (2010).
[24] Yu, L., Lutterodt, H. and Cheng, Z. Beneficial health properties of psyllium and approaches to improve its functionality. In: *Advances in Food and Nutrition Research. Taylor, S. (ed.).* **55**:193-217 (2009).
[25] Zandonadi, R.P., Botelho, R.B. and Araújo, W.M.,. Psyllium as a substitute for gluten in bread. *J. of the American Dietetic Association.* **109**(10):1781-4 (2009).
[26] http://www.medicinalfoodnews.com/vol04/issue3/psyllium.htm. Medicinal Food News.
[27] http://en.wikipedia.org/wiki/Psyllium. htm.

Table 1: Nutritional Quality of Plantago seeds

Protein	Fat	Engery	Total Dietary fibre	Insoluble fiber	Soluble fiber
17.4%	6.7%	4.75 kcal/g	24.6%	19.6%	5.0%

Table 2: Fractional Carbohydrates Composition of Psyllium Husk (gained attention due to its health improving properties)

Rhamnose	Arabinose	Galactose	Glucose	Xylose	Mannose	Arabinoxylan
1.50	21.96	3.76	0.64	56.72	0.40%	> 60%

Figure 1: Psyllium Husk (Isabgol)
Sources: Van-Craeyveld *et al.* 2009