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Role of Isabgol in Human Health

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Abstract

Isabgol contains 6.83% moisture, 0.94% protein, 4.07% ash and 84.98% of total carbohydrates. 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%). The present research was carried out to characterize and utilize Isabgol for formulation and evaluation of Dietic cookies. Isabgol exerted its hypolipidemic effect by affecting bile acid absorption and altering hepatic cholesterol metabolism.

It is widely used as wounds healing agent and gastric disorders. Seed mucilage is used in cosmetics and as a basic stabilizer in the ice-cream industry. The World Health Organization (WHO) has approved the use of Plantago as a laxative agent, to treat hypercholesterolemia and to reduce the blood glucose.

The seeds are swollen up after placing into the mouth or in water. Covering layer of its seeds is famously known as saboos-e-Asapghol. The taste of seeds is insipid and mucilaginous.

Fast dissolving tablets of the poorly soluble drug, carbamazepine showing enhanced dissolution, would lead to improved bioavailability, improved effectiveness and hence better patient compliance by using natural superdisintegrant like Plantago ovalata (PO) mucilage. PO seed powder and mucilage powder were effective in low concentrations (5%) as disintegrants compared to others.

Utility of Isbagol, mainly in hypercholesterolemia men, have suggested that it lowers serum cholesterol as an outcome of the binding of bittering acids in the stomach lumen and abridged risk of coronary heart disease.

Ispaghula is nominated in Iran as ESFARZEH, and used mainly for its emollient effect. In Iranian folk medicine, there is a report on its anti-diabetic effect. If the product is taken together with meals in the case of insulin dependent diabetics, it may be necessary to reduce the insulin dose. Due to potential reductions in blood sugar levels caused by Isbagol, requirements for insulin or other diabetes drugs in diabetic patients may be reduced.

Obstruction of the gastrointestinal tract has been noted in numerous cases with Isbagol containing laxatives, particularly in individuals with previous bowel surgery or problems, and/or when the laxatives are mixed with inadequate amounts of water.

A few functional foods have been developed using Isbagol as the bioactive component and marketed for reducing total serum and LDL cholesterol.

The ratio of lithocholic to the deoxycholic acid tends to be reduced during treatment with ispaghula husk and there are also statistically significant reductions in the ratio of total litho-cholic acids to deoxycholic acid multiplied by the total bile acid output.

Introduction

Asapghol is used as a folk medicine in the northern part of Anatolia in Turkey. It is widely used as wounds healing agent and gastric disorders. Seed mucilage is used in cosmetics and as a basic stabilizer in the ice-cream industry. The World Health Organization (WHO) has approved the use of Plantago as a laxative agent, to treat hypercholesterolemia and to reduce the blood glucose (Pullaiah, 2006).

The seeds are swollen up after placing into the mouth or in water. Covering layer of its seeds is famously known as saboos-e-Asapghol. The taste of seeds is insipid and mucilaginous (Hakim, 2011; Kabiruddin, 2007 and Ghulam, 2007).

The plant of Isabgol is indigenous to the Mediterranean region and West Asia. It is introduced into India and cultivated in North Gujarat, Rajasthan, Punjab, Uttar Pradesh, and Haryana and to a small extent in West Bengal, Karnataka and Coromandal coast, Sidhpur in Baroda state. It is widely distributed in Punjab, Sind, and Persia (Anonymous, 2003 and Nadkarni, 2007)

Mubarrid (Refrigerant) (Kirtikar & Basu, 2005 and Dymock, 2005), Mushil(Purgative), Muhallil-e-Auram(Antiinflammatory), Iltehab(Inflammation) (Ibn Sina.Al-Qanoon fit Tibb, 2007).

Motamedi et al., (2010) carried out a study on the antibacterial effect of ethanolic and methanolic extracts of PO and Oliveria decumbens endemic in Iran against some pathogenic bacteria. The results of the study showed that these plants had a proper antibacterial effect and could be considered as a new source of antibiotic discovery and development for infectious disease treatment purposes.

In another study, Bokaeian et al., (2014) studied the antibacterial activity of silver nanoparticles produced by PO seed extract against antibiotic-resistant Klebsiella pneumonia. The seeds of PO were used for silver nanoparticle synthesis. It was concluded that at a specific dose, chitosan-based AgNPs killed bacteria without harming the host cells, thus representing a potential template for the design of antibacterial agents to decrease bacterial colonization and to overcome the problem of drug resistance.

The results of the study showed that Ispaghula has agut-stimulatory effect, mediated partially by muscarinic and 5-HT4 receptor activation, which might complement the laxative effect of its fiber content, and a gut-inhibitory activity possibly mediated by blockade of Ca2 channels and activation of NO-cyclic guanosine monophosphate pathways (Mehmood et al., 2011).

Sahagun et al., (2015) studied the antiulcerogenic effect on the duodenal mucosa of the soluble fiber PO husk. On the basis of results of the study, it was suggested that PO husk might protect intestinal mucosa probably by limiting acetylsalicylic acid penetration into epithelial cells although further studies were needed to confirm the same effect in other experimental models of induced mucosal damage and to elucidate the mechanisms of fiber protection.

Romero et al., (2002) studied the potential hypolipidemic effects of the seeds from the PO and the mechanisms associated with the lowering of plasma lipids. Male Hartley guinea pigs (n = 30; 10 per group) were fed either a control diet or diets containing 7.5 or 10 g/100 g PO for 4 wks. The results of the study suggested that PO exerted its hypolipidemic effect by affecting bile acid absorption and altering hepatic cholesterol metabolism.

In a study, Pandita (2013) analyzed the cytomeiotic activity of PO. It was generally an in-breeder and was characterized with the narrow genetic base, because of low chromosome number, chromosome size, chiasmata frequency, recombination index and abundance of heterochromatin in chromatin material. The various stages of meiosis viz; Pachytene, Diplotene, Diakinesis, Metaphase, and Anaphase were observed. The number of rod bivalents was 04 in PO. The recombination index at Diakinesis of PO and at Metaphase was10 and 7, respectively. The personalization coefficient was 0.33 in PO.

Rao et al., (2010) formulated and evaluated the development of fast dissolving tablets of the carbamazepine by wet granulation method, using different concentrations of a natural super-disintegrating agent like PO seed powder and mucilage. The results of the study concluded that fast dissolving tablets of the poorly soluble drug, carbamazepine sh owing enhanced dissolution, would lead

to improved bioavailability, improved effectiveness and hence better patient compliance by using natural superdisintegrant like PO mucilage.

Devesvaran et al., (2009) studied the disintegrating properties of mucilage and seed powder of Isabgol (PO) by formulating dispersible tablets of famotidine. The results of uniformity of dispersion showed that no particles were retained on sieve no. 22 and the in vitro dissolution profile exhibited maximum drug release from all the formulations.

Srinivas et al., (2003) carried out a study of Ocimum basilicum and PO as disintegrants in the formulation of dispersible tablets. The results of the study showed that PO seed powder and mucilage powder were effective in low concentrations (5%) as disintegrants compared to others.

Gums and mucilages are widely used natural materials for food and pharmaceutical industries. The natural materials have advantages over synthetic ones since they are chemically inert, nontoxic, less expensive, biodegradable, and widely available (Jan et al., 2009). These can also be modified in different ways to obtain tailor-made materials and thus can compete with the available synthetic polymers. The importance of biocompatible and biodegradable hydrophilic polymers has wide applications in different fields such as polymer engineering, chemical engineering, pharmaceuticals, food, and agriculture because of their propensity to combine with others (Peppas et al., 2000). The blends of these biopolymers are also of significant importance and recently have been investigated for application in drug delivery systems and in the field of foods science (Immirzi et al., 2003 and Mandala et al., 2004). Amongst the various polymers employed, hydrophilic biopolymers are quite suitable because they are nontoxic and acceptable by the regulatory authorities (Kulkarni and Sa, 2008). The application of any natural gum or mucilage depends upon its viscosity. The choice of selecting the natural gum and its blends for sustained release effect depends upon its gelling strength (Kumar et al., 2008).

Isabgol husk is medicinally important polysaccharide and it has been reported for the treatment of constipation, diabetes, diarrhoea, inflammation bowl diseases, ulcerative colitis, cancer, obesity, high cholesterol, and so forth (Singh et al., 2008).

Recently, the US Food and Drug Administration has authorized the use of food products containing soluble fiber from Isabgol husk [Jenkins et al., 2002). A gastroretentive sustained release delivery system of ofloxacin has been developed with release polymers like psyllium husk and a swelling agent, crospovidone (Chavanpatil et al., 2005 and 2006).

The consumption of cereal containing snacks like cookies requires the development of an adequate substitute for wheat. The substitute should be like that is readily present, cost-effective and can replace wheat flour in terms of functionality (Herminia et al., 2017).

Isabgol husk is botanically obtained from dried ripe seeds of Plantago ovata Forkal, family Plantaginaceae. It consists of the seeds of Plantago psyllium and Plantago arenaria. Ispaghula and Psyllium are invariably named as psyllium. The US National Formulary Ispaghula (also called as Isabgol) husk regulates the bowel function and is most widely used as over the counter drugs to treat constipation (Ravi Kumar and Kumar, 2001).

Psyllium mucilage has a long history as a nutritional supplement due to its considerable amount of soluble and insoluble fiber being reported as a medicinally active gel forming natural polysaccharide, successfully used for the treatment of high cholesterol, diabetes, obesity in children, remediation of constipation, diarrhoea, inflammation bowel diseases and ulcerative colitis (Singh, 2007).

The seed and husk of Isabgol contain mucilage which is present in the epidermis of the seed. It is official in IP (Indian Pharmacopoeia), BP (British Pharmacopoeia), and USP (United State Pharmacopoeia) (Ziai et al., 2005).

It contains 6.83% moisture, 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%). The present research was carried out to characterize and utilize Isabgol for formulation and evaluation of Dietic cookies (Guo et al., 2008).

Psyllium husk is obtained from the seed of the Plantago ovateplant. Psyllium is also recognized as ispaghula and isabgol widely used as a laxative. Isabgol comes from the Persian words as band ghoul, meaning “horse flower” which is descriptive of the shape of the seed (Kumar et al., 2016; Rao et al., 2017; Ricklefs-Johnson et al., 2017; Sukhija et al., 2016; Yu et al., 2017 and Nayak and Singh, 2001).

The mucilage can be obtained by mechanical milling/grinding, and is usually referred to as husk (Romero et al., 2002).

Plantago seeds popular as black, Spanish or French in trade market. Psyllium is obtained from Plantago psyllium and Plantago arenaria (Praznik et al., 2017 and Rao et al., 2016). Gujarat and Rajasthan are collectively reported to have an area of about 61,000 hectares under its cultivation (Janin, 2003). Its purification is carried out by precipitation in aqueous solution with alcohol and it was finally washed with acetone and dried (Bhatia and Ahuja, 2015 and Hosseini et al., 2015). Psyllium is a natural polysaccharide carried out from Plantago psyllium and its mucilage is consisting of arabinoxylan (arabinose 22.6%, xylose 74.6%). The physiologically reactive component of Psyllium husk is exhibit to be a greatly branched arabinoxylan (Pal et al., 2014 and Thakur and Thakur, 2014).

It is widely used as a home medicine in all cultures, in many types of diseases, situations like diarrhea, as bulk forming, chronic constipation, non-irritant laxative drug, inflammation of the mucous membrane of gastro intestine and genitourinary tracts, gonorrhea, duodenal ulcer, piles, demulcent as a cervical dilator etc. (Mishra et al., 2016 and Kaith and Kumar, 2007). Marlett and Fischer (2003) investigated that in contrast to arabinoxylans in cereal a grain that is extensively fermented, psyllium husk have a structural application, as yet unidentified, and that hinders its fermentation by typical colonic micro flora. Fischer et al. (2004) investigated that Psyllium has a powerful capacity to obtain a gel in water and through animal and human feeding experiments, so psyllium is a mucilaginous fiber.

Kaith and Kumar (2008) investigated that the spectra of Psyllium has broad absorption band at 3401 cm^{-1} which can be credited to –OH stretching of alcohol.

Sen et al. (2012) studied the surface morphology of psyllium they were analyzed in scanning electron microscopy (SEM) in powdered form (Model: JSM-6390LV, Jeol, Japan).

The analysis was performed to examine the changes in the thermal properties of the Psyllium brought about by graft copolymerization with acrylamide and acrylic acid in different reaction conditions studied by Kumar et al. (2010).

Thrombogenicity results specify that graft copolymers are non-thrombogenic as the weight of clot shaped and thrombus percentage for graft copolymer was less than the positive control (Singh et al., 2008).

Natural carbohydrates, polymers are hydrocolloids, used as gel forming components, sweetener, binder, flavouring agents, lubricants, taste masking agents to prepare easy to swallow compositions. One of the trends in this area is of study the useful substances of natural origin, for such substances tend to be biodegradable, biocompatible and non-toxic (Ziai et al., 2003).

The treatment should, however, last more than a month as no amelioration was noted in another trial of 30 days. Less evidence is available for the effectiveness of fiber in the treatment of uncomplicated diverticulitis yet widely used among patients to relieve over all symptoms (Chaplin et al., 2000).

In view of the pharmacological significance of psyllium polysaccharides to decrease glucose absorption as well as drug delivery strategies based on hydrogels, psyllium, if appropriately tailored to synthesize the hydrogels, can work as the double potential candidates to improve new drug delivery systems (Singh and Kumar, 2008).

The results from the study suggested that Plantago psyllium ovate could be used with sureness for the long-term action of mild-to-moderate hypercholesterolemia studied with Oliver and coworker (Anderson et al., 2000).

Microwave irradiation meaningfully reduced the use of poisonous solvents as well as the reaction period in mostly the grafting reaction of interest here, ensuring high yields product selectivity and cleans product formations (Singh et al., 2012). Among different hydrogels, drug delivery devices, especially based on polysaccharides have concerned considerable attention as a better candidate for controlling release of the rapeuticagents (Singh, 2007). Singh, et al. (2012) studied the modified psyllium with acrylic acid based graft copolymer also used in colon precise drug delivery (Singh et al., 2006). This observation was very significant for emerging the colon specific drug delivery systems and it was observed from the rate of release and release trends that the release of insulin was occurring only at higher pH which corresponds to the colon studied by Singh et al. (2007). Singh et al. (2009) studied the dynamics of model drug anticancer 5-fluorouracil was released from psyllium and polyacrylic acid polymeric networks. Singh et al. Singh et al. (2008) reported that the tetracycline hydrochloride drug and dynamics of model antibiotic drug rifampicin were released from the modified psyllium with methacrylamide through radiation cross linked polymerization. Singh et al. (2007) studied that the tetracycline hydrochloride drug was released from the improved psyllium

with methacrylamide poly (MAAm) polymeric networks through using N, N-MBAAm as cross-linker and ammonium persulfate (APS) as initiator which used in colon specific drug delivery. (Singh and Sharma , 2008) observed that dynamics model of the drug tetracycline hydrochloride was also released from the modified polysaccharide psyllium with 2-hydroxylethylmethacrylate (2-HEMA) and acrylamide (AAm)-based polymeric networks.

Singh and Sharma studied that the model of antibiotic drug tetracycline hydrochloride was also released from the modified psyllium with poly (vinyl alcohol) and poly (acrylic acid) in different release medium at 37°C was observed more in pH 2.2 buffer, hence these hydrogels were suitable for peptic ulcer caused by helicobacter pylori. The release of antibiotic drug tetracycline hydrochloride from the drug loaded polymer was more observed in pH 2.2 buffer solution (Singh and Sharma, 2010). The hemolytic potential of psyllium-cl-PVA The hemolytic percentage of hydrogen was found to be 4.51 ± 0.37%. Psyllium-cl-PVA hydrogel having haemolytic percentage between 2 and 5% was found to be partially haemolytic (Singh et al., 2012). The quantity of drug release in pH 7.3 buffers was higher than the release medium of 2.3 pH buffer and distilled water (Singh et al., 2007). Reports the utility of psyllium, mainly in hypercholesterolemia men, have suggested that it lowers serum cholesterol as an outcome of the binding of bittering acids in the stomach lumen and abridged risk of coronary heart disease. The mechanism of action of psyllium's hypercholesterolemia effects has not been completely elucidated (Chourasia and Jain, 2003 and Singh and Bala, 2014).

Brennan studied, that that psyllium may serve as a hypoglycemic agent in healthy human subjects as well as patients with diabetes. It helps control the rise of blood glucose following a meal. They suggested moderate decreases in blood sugar levels after a single quantity of psyllium, with unclear long-term effect (Brennan, 2005). Water soluble nutritional fibers, reduction postprandial glucose concentrations and decrease serum cholesterol concentrations in men with type -2 diabetes. Initial or unrestrained studies suggested that psyllium improved glycemic and lipid control in individuals with type -2 diabetes. The capacity of soluble fibers to decrease the postprandial glucose reaction to meals eaten some hours after fibre ingestion (second meal effect) was shown previously in non-diabetic individuals. It also reduced insulin recruitment in patient with diabetes mellitus (Clark et al., 2006).

Psyllium is used to increase the bulk of stool and reduced the time of transits and also reduced the revelation of the intestinal wall to the deadly compounds, which is found in the stool. Although the underlying mechanisms of psyllium is cancer prevention capability are still not thoroughly clear, a large body of research has been done to reveal the possible effects (Sierra et al., 2001). By clinical assessments of irritable bowel syndrome in patients, a dosage of 20 g psyllium per day was postulated to be the optimum dosage. The laxative effect of psyllium was considered to be mainly due to its water soluble and gel-forming capacity (Bliss et al., 2001).

U.S. Food and Drug Administration now authorized the use of health claims on food products from psyllium that state that they were connected with a decreased danger of coronary heart disease. The addition of isabgole to traditional nourishment for people with diabetes is safe, is well tolerated, and improves glycemic and Lipid control in men with type diabetes and hypercholesterolemia (Anderson et al., 2000).

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 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 byIsabgol (plantago ovata forskal) is rigid, difficult to brake, to dissolve (Majmudar et al., 2002). Hydrophobicity of the psyllium seed hydrocolloid and 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).

A factor in physiological fibre behavior of psyllium gum is its high viscosity and gel-like character in water (Al-Assaf et al., 2003).

Gel-forming fraction of the alkali extractable polysaccharides of psyllium is composed of arabinose, xylose and traces of other sugars (Fischer et al., 2004).

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).

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 A1and 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). 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 1996and 1803 in control and fiber cookies, respectively (Vega-Lopez et al., 2001).

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).

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). 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).

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).

However, diet enriched with fiber significantly reduced total cholesterol and LDL thereby ultimately declines metabolic syndrome risk factors (Pal et al., 2011).

The foremost fiber sources are psyllium husk, oat, guar gumand some other cereals. However, psyllium husk fiber appears one of the effective sources with least adverse effects (Galisteoa et al., 2010). 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 aslaxative can be due to its bioactive components, namely phenolic compounds such as a cetoside 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).

Ispaghula is nominated in Iran as ESFARZEH, and used mainly for its emollient effect. In Iranian folk medicine, there is a report on its anti-diabetic effect (Ziai et al., 2003). All the three side chains are attached to either O-2 or O-3 of xylose in the polymer back bone. The back bone has both (1>3) and (1>4) -ß-linkages but their sequence and the distribution of side chains, have not yet been determined (Fisher et al., 2004).

If the product is taken together with meals in the case of insulin dependent diabetics, it may be necessary to reduce the insulin dose (Fugh-Berman, 2000). Due to potential reductions in blood sugar levels caused by psyllium, requirements for insulin or other diabetes drugs in diabetic patients may be reduced (Sierra et al., 2002).

In order to decrease the risk of gastrointestinal obstruc-tion (ileus), Ispaghula husk should only be used under medical supervision together with medicinal products known to inhibit the peristaltic movement (e.g. morphinomimetics, loperamide) (Boullata, 2005).

One study in female rabbits showed that while guar gum re-duced the absorption of ethinylestradiol, psyllium actuallyslightly increases the total absorption; however the absorp-tion rate was slow (Garcia et al., 2000).

Obstruction of the gastrointestinal tract has been noted in numerous cases with psyllium-con-taining laxatives, particularly in individuals with previous bowel surgery or problems, and/or when the laxatives are mixed with inadequate amounts of water (Marlett et al., 2000).

A few functional foods have been developed using psyllium as the bioactive component and marketed for reducing total serum and LDL cholesterol (Yu et al., 2001). Yu and Perret (2003) developed an enzymatic method to produce absorbing capacity and different gelling properties.

Chaplin et al. (2000) showed that the ratio of lithocholic to the deoxycholic acid tends to be reduced during treatment with ispaghula husk and there are also statistically significant reductions in the ratio of total litho-cholic acids to deoxycholic acid multiplied by the total bile acid output.

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