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Phosphorylation of psyllium seed polysaccharide and its characterization

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ABSTRACT

Psyllium is widely used as a medicinally active natural polysaccharide for treating conditions like constipation, diarrhea, and irritable bowel syndrome, inflammatory bowel disease, ulcerative colitis and colon cancer. Studies have been performed to characterize and modify the polysaccharide obtained from psyllium seed husk and to evaluate its use as a pharmaceutical excipient, but no studies have been performed to evaluate the properties of the polysaccharide present in psyllium seeds. The present study focuses on phosphorylation of psyllium seed polysaccharide (PPS) using sodium tri-meta phosphate as the cross-linking agent. The modified phosphorylated psyllium seed polysaccharide was then evaluated for physicochemical properties, rheological properties, spectral analysis, thermal analysis, crosslinking density and acute oral toxicity studies. The modified polysaccharide (PhPPS) has a high swelling index due to which it can be categorized as a hydrogel. The percent increase in swelling of PhPPS as compared to PPS was found to be 90.26%. The PPS & PhPPS mucilages of all strengths were found to have shear thinning properties. These findings are suggestive of the potential use of PhPPS as gelling & suspending agent. PhPPS was found to have a mucoadhesive property which was comparable with carbopol.

1. Introduction

Pharmaceutical excipients are substances other than the active pharmaceutical ingredient—that are used in the finished dosage form or may be used as processing aids in the manufacture of active pharmaceutical ingredients [1]. The properties of the final dosage form (i.e., its bioavailability and stability) depend on the excipients chosen, their concentration and interaction with both the active compound and each other. A detailed knowledge of the physical and chemical properties as well as the safety, handling and regulatory status of these materials is essential for formulators throughout the world [2]. Majority of the widely used excipients are obtained from synthetic sources. Although excipients are considered to be pharmacologically inert, it is now well accepted that some have potential for untoward effects. Besides this, problems of incompatibility, stability and high cost are evident in synthetic excipients [3]. There are several polysaccharides of plant origin which have been used as excipients. Polysaccharides consist of a large number of polymeric carbohydrate molecules composed of long chains of monosaccharide units linked together in a long chain by glycosidic bond [4]. The pharmaceutical excipients of plant origin, like starch, agar, alginates, carrageenan, guar gum, xanthan gum, gelatin, pectin, acacia, tragacanth, cellulose etc. find applications in the pharmaceutical industry as binding agents, disintegrants, sustaining agents, protective colloids, thickening agents, suspending agents, emulsifiers, gelling agents, bases in suppositories, stabilizers, and coating material [5–10].

Psyllium has been in use as a medicinal agent since ancient times throughout the world and it is official in compendia of many countries. The dried, ripe seeds of *Plantago afra* (*Plantago psyllium*), *Plantago indica* (*Plantago arenaria*) & *Plantago ovata* (Plantaginaceae) are used in medicine. Seeds of *P. ovata* Forsk are commercially referred to as Indian psyllium or Ispaghula [11–13]. Psyllium is used worldwide for the treatment of constipation, diarrhea, irritable bowel syndrome, inflammatory bowel disease, ulcerative colitis, colon cancer, diabetes and hypercholesterolemia [14,15]. Psyllium seed mucilage contains 22.6% arabinose, 74.65% xylose, traces of other sugars and 35% non-reducing terminal residues [16]. Researchers have studied the physiologically active, gel-forming fraction of the alkali-extractable polysaccharides of *P. ovata* Forsk seed husk. The polysaccharide from the seed husk has been fractionated and evaluated for gelling ability [17]. Kaith and Kumar carried out grafting of acrylic acid onto psyllium backbone

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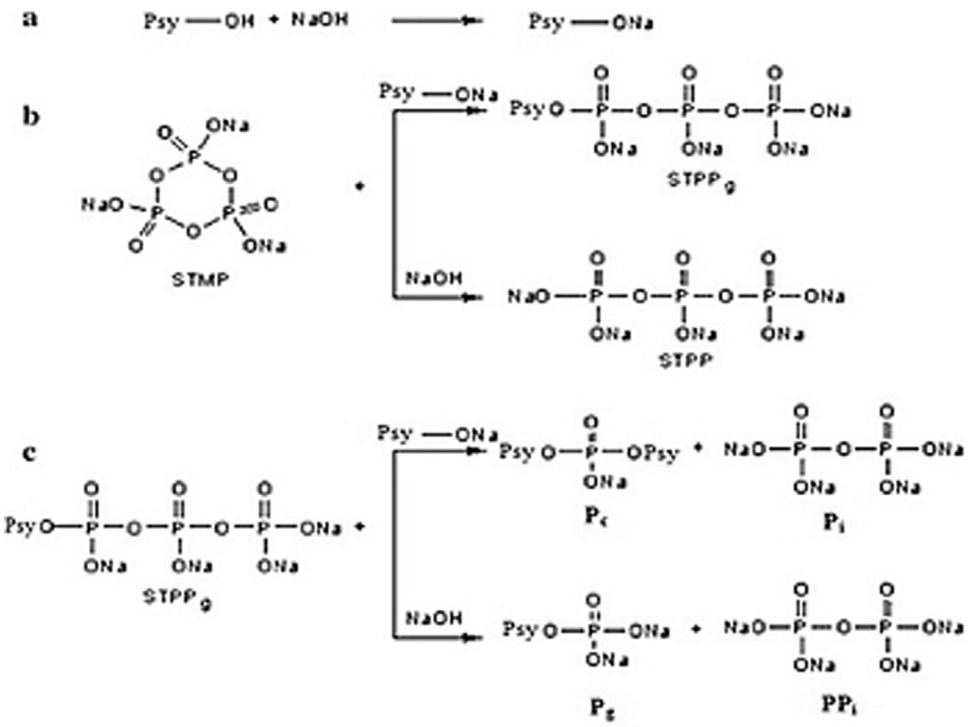

Fig. 1. Reaction steps and mechanism of crosslinking.

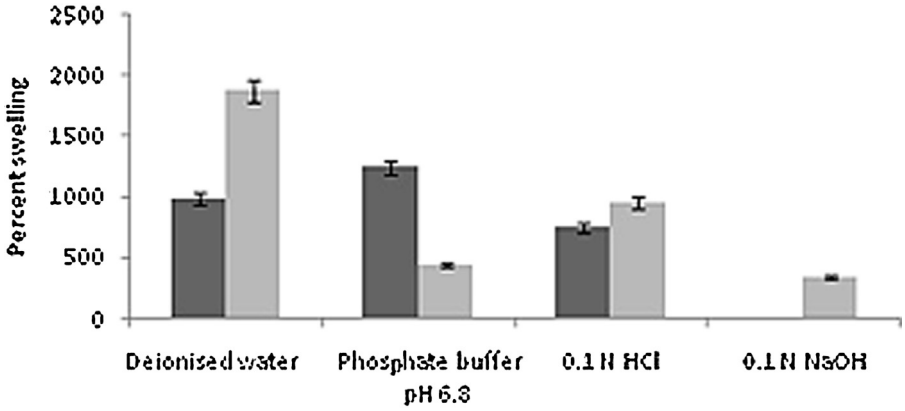

Fig. 2. Percent swelling indexs.

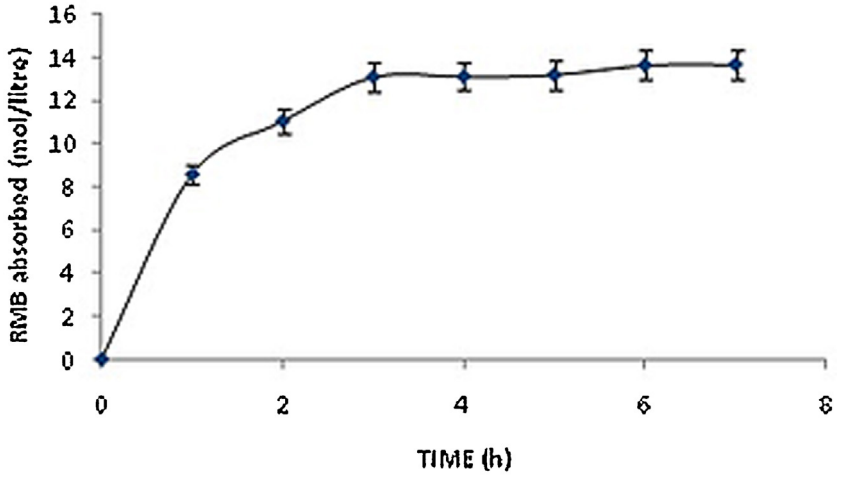

Fig. 3. RMB absorbed (PhPPS).