Efficacy of tamarind seed polysaccharide in products development.

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ABSTRACT

Tamarind seed is an underutilized by-product of tamarind pulp industry. In Thailand, only small fraction of the seeds, in the form of tamarind kernel powder (TKP), is produced and exported. Though there are some uses for decorticated seeds as a binding material in traditional Thai mural painting, there have been hardly any other uses in food and non-food Thai industries. Extraction and purification of xyloglucan, a non-toxic polysaccharide from TKP, was obtained in order to be used as a texture modifier. Since the aqueous solution of xyloglucan has high viscosity and stability against acids and heat with film forming properties, we have examined the potential usage of xyloglucan as an excipient in pharmaceutical dosage forms such as, nanoemulsion, dry emulsion and transdermal films. The xyloglucan was used as viscosifiers in preparation of acrylic resin and water color paint for art. Furthermore, we have shown that pretreatment of cotton and silk surface with xyloglucan can enhance the quality of inkjet printing on the fabric.

Keywords: Tamarind seed polysaccharide, Xyloglucan
1. INTRODUCTION

Tamarind seed is a by-product of the commercial utilization of the fruit, the pulp is usually removed from the pod and used to prepare juice, jam, syrup and candy. The seed comprises the seed coat or testa (20-30%) and the kernel or endosperm (70-75%) [1]. Tamarind seed is the raw material used in the manufacture of tamarind seed kernel powder (TKP). In India, TKP is used as a source of carbohydrate for the adhesive or binding agent in paper and textile sizing, weaving and jute products as well as textile printing [2].

Xyloglucan is a non-ionic polysaccharide extracted from TKP and it is composed of a [1, 4] β- D-glucan backbone which has [1, 6] α-D- xylose branches that are partially substituted by [1, 2] β- galactoxylose (Figure 1). The glucose, xylose and galactose units are present in the ratio of 2.8:2.25:1.0 [3]. The average molecular weight of xyloglucan is 52,000-56,000 or around 115,000 depending on the method of measurement.

Xyloglucan is insoluble in organic solvent and dispersible in hot water to form a highly viscous solution with a broad pH tolerance and high thermal stability [4]. This property led to its application as stabilizer, thickener, gelling agent, binder in food industry, particularly in Japan where it is a permitted food additive [5].

Due to its unique rheological properties with mucoadhesivity, biocompatibility and high drug holding capacity xyloglucan is a suitable carriers for the development of novel pharmaceutical formulations and for drug delivery system [6-7].

The general objective of the present study is therefore to evaluate the usage of xyloglucan in various products. The products included, (i) use as an excipient in pharmaceutical dosage forms such as, nanoemulsion, dry emulsion and transdermal films, (ii) use as viscosifiers in preparation of acrylic resin and water color paint for art and finally (iii) use xyloglucan to treated surface of cotton and silk fabrics before inkjet printing.

2. MATERIALS AND METHODS

Preparation of xyloglucan

Method 1 (X1)

20 g of tamarind seed kernel powder was added to 200 ml of cold distilled water to prepare slurry. The slurry obtains is then poured into 800 ml of boiling water and are maintained at 80°C for 30 min. and kept overnight at room temperature. A clear solution was separated and poured into ethanol with continuous stirring to obtain a gelatinous precipitate. Then the precipitate was drained on cheesecloth and oven dried. The obtained polymer was stored in a desiccator.

Method 2 (X2)

20 g of tamarind seed kernel powder was added to 1000 ml of cold distilled water to prepare slurry. The slurry obtains was left to stand for 4 hours so most of the large particle size TKP portion was settled down. Then the precipitate was resuspended in water, heat to 80°C for 30 min. and kept overnight at room temperature. A clear solution was separated and poured into ethanol with continuous stirring to obtain a gelatinous precipitate. The precipitate was drained on cheesecloth and oven dried. The obtained polymer was stored in a desiccator.
Xyloglucan use as pharmaceutical excipient.

Preparation of nanoemulsion
Stable nanoemulsion formulation was prepared from Tween80 castor oil/xyloglucan (X2) using high energy homogenization (Ultra-Turrax® T50 Basic, IKA, Germany) at 20,000 rpm for 15 min.

Preparation of dry emulsion
The liquid o/w-emulsions were prepared with 50% dry powder mass. The aqueous solution containing dissolved HPMC or HPMC with Xyloglucan(X2) and coconut oil were homogenized in a high speed colloid mill (Ultra-Turrax® T25 basic IKA, Germany) for 3 min at 24,000 rpm. The liquid o/w-emulsions were dried at 70°C.

Preparation of film
Solution of 1% xyloglucan(X1) was prepared by dissolving in 10% w/v propylene/glycerol solution. The above solution (20 g) was poured into a petridish and kept in an oven at 60°C for complete drying. The dried films were removed from the petridish and stored in a desiccator until use.

Xyloglucan use as viscosifier for paint
Xyloglucan (X1) solution was used to substitute gum Arabic or maltodextrin in water color base formulation. In acrylic paint formulation, xyloglucan (method1) solution was used to replace some of acrylic emulsions.

Xyloglucan use as textile surface coated
Cotton and silk fabrics were coated with xyloglucan (X1) solution using padding machine. Coated fabric was printed with inkjet printer using program Greatag Macbeth@2004 and follow with heating at 100°C for 5 min.

3. RESULTS

Aqueous extraction of TKP yield 50% and 30% of xyloglucan (w/w) by method 1 and 2 respectively. The absence of the contaminating proteins in xyloglucan (method2) is verified by sodium dodecyl sulfate-Polyacrylamide gel electrophoresis (Figure 1). This purified xyloglucan was further use as a carrier in various drug delivery systems. It was possible to formulate nanoemulsion (100-500 nm) which composed of 30% castor oil, 20% Tween80 and 3% xyloglucan. The prepared nanoemulsion were stable for 14 day at 8°C. (Figure 2). Dry emulsion containing HPMC or HPMC/xyloglucan as emulsifier were prepared with 50% coconut oil. The reconstitution properties of xyloglucan containing dry emulsion can reformed the o/w-emulsion comparable to HPMC containing dry emulsion. (Figure 3). Xyloglucan with 10% plasticizer (PG/glycerol) showed excellent film-forming characteristics. The cast films were transparent and uniformly smooth and flat (Figure 4).

Xyloglucan prepared by method1 was used as a rheology control additive in both water base and acrylic base color emulsion. It is possible to prepared both water and acrylic color paint with good quality when compare to standard. (Figure 5).

Furthermore, the xyloglucan was used as pretreatment for coated cotton and silk fabrics before inkjet printing. The quality of the coated printing products were improved in printing sharpness and wider color area (Figure 6).
Figure 3. Reconstituted of dry emulsion in water of (a) HPMC (b) HPMC/xyloglucan from inverted microscopy.

Figure 4. Transparent xyloglucan film prepared from 1% (w/w) xyloglucan with 10% plasticizer (PG/glycerol).

Figure 5. Twelve color of water base paint (a) Water color and (b) Acrylic color.

Figure 6. Color area of the treated and untreated fabrics is shown in a*b* diagram of the untreated and treated cotton (a) and silk (b).
4. CONCLUSIONS

Tamarind seed is a typical underutilized material in Thailand. In this study, xyloglucan was extracted and purified from tamarind seed kernel and was explored to find an application in various products ranging from pharmaceutical excipient to emulsifier in color paint and as the surface coated on fabrics to improve printing quality. It is desirable that more works has to be done to increase the use of this unexploited tamarind seed polysaccharide.

ACKNOWLEDGEMENTS

This work was supported by the Agricultural Research Development Agency (ARDA), Thailand

REFERENCES