



Commentary

A Narrative Review on Xanthan Gum Characteristics: A Thickening Agent Used for Dysphagia

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ABSTRACT

Dysphagia is a difficulty transferring liquid/food from the mouth to the stomach. It has life-threatening complications which can be reduced by thickening agents. There are various thickeners such as gelatin and xanthan. Each of these have their own characteristics. As Gelatin is melt in mouth, it is not an ideal agent for patients with dysphagia. However, xanthan gum has significant advantages in most important aspects of clinical applications like pH and temperature compatibility, consistency, appearance, odor, required concentrations of adequate liquid thickening, and resistance to amylase. Therefore, despite some issues like the interaction with some oral drugs, generally Xanthan gum is the best choice to use for improving the swallowing ability of patients. Hence, the aim of this narrative review is to report the main characteristics of xanthan gum to make researchers and practitioners familiar with it and consider it in their works.

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Dysphagia is an abnormality in swallowing foods and/or liquids [1, 2]. Strokes, drugs, traumas, cancers, infections, intubation, neurodegenerative and neuromuscular diseases may directly or indirectly cause dysphagia. Although 2.3-16% of the entire population worldwide suffers from oropharyngeal dysphagia [3], dysphagia prevalence has increased when comorbid with other diseases, up to 80% in Parkinson diseases, and 91% in elderly people with community acquired pneumonia [2, 4, 5]. Due to patients' inability to consume adequate food and liquids, malnutrition and dehydration may occur [2, 6, 7]. Oral health problems as well as malnutrition in patients with dysphagia will increase the risk of aspiration pneumonia which can increase the risk of death 3 times [5, 7, 8]. Dysphagia have other life-threatening complications such as depression,

anxiety and lowered quality of life [5, 9]. Therefore, interventions become necessary in order to prevent the abovementioned problems. A typical solution of dysphagia is-modifying the viscosity of food/liquids. An efficient technique in liquid modification is increasing the viscosity of liquids. The mechanism has not yet been clarified, but maybe it requires longer time for patients to manage the transferring process of the bolus [10]. Many studies confirmed the efficacy of thickening agents in the development of safe swallowing in dysphagic patients [11]. Nevertheless, the disadvantages of thickened liquids such as more required tongue strength and aversion to thickened liquids make it unpopular in some cases, and apparently there are no better substitutes available now [12]. Various thickening agents like Agar, Carrageenan gum, locust bean gum, psyllium gum, gellan gum, gelatin, guar gum, starches, and Xanthan gum can be used for dysphagia management, but a thickening agent must have some essential properties like viscosity consistency, pH and temperature compatibility, palatability, efficacy,

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and less mouth and pharyngeal residue production [12]. In Iran, there is no commercial thickening agent [5] and according to our knowledge, Iranian clinicians and researchers prescribe and use gelatin to thicken the liquids. In this connection, a main problem with gelatin is its “melt-in-the-mouth” property [13]. In Iran, Xanthan gum is the most prevalent and acceptable ingredient of gum-base commercial thickener formulations [12].

The aim of this narrative article is to review the characteristics of Xanthan gum to attract dysphagia clinicians and researchers in using Xanthan as a thickener in their studies instead of gelatin.

What Is Xanthan Gum?

Xanthan gum, a natural water-soluble extracellular polysaccharide, was discovered in the 1950s. Some species of the genus *Xanthomonas* (a genus of *Pseudomonas* family), like *X.campestris* as a plant-pathogenic bacterium, produce this gum with molecular weight range of [14]. The Food and Drug Administration of the United States has approved Xanthan as a food additive with no specific quantity limitations [15]. Xanthan gum is widely used in food, pharmaceutical and cosmetic industries due to its stabilization, compatibility, and rheological properties [15].

Xanthan Gum Efficacy

Significant reduction in the aspiration risk is demonstrated in many studies as the viscosity of liquids is increased [16]. Usual viscosity use of liquids in dysphagia management starts from 51 to over 1750 centipoise (cP) (37 °C, shear rate 50 / second). This thickening range consists of three main stages: 1) viscosity range of 51-350 cP, 2) 351-1750 cP, and 3) higher than 1750. However, the number of stages and the name of their textures in each stage vary across countries; in one of the most common nomenclatures, these three stages are named Nectar-like, Honey-like, and Pudding-like or spoon thick, respectively [17]. Xanthan gum produces sufficient viscosities with concentrations below 1%, requiring only a slight amount of powder [18].

One of the most critical issues in using commercial thickening agents are oral and pharyngeal residues. Residues which are produced by some thickeners cause post-deglutition aspiration with relative consequent issues. In cases of weaker anterior and/or posterior tongue muscles and bolus propulsion, risk of residues may increase remarkably [19]. Fortunately, despite other especially starch-base thickeners in spoon thick viscosity, Xanthan gum-base thickeners almost do not increase residues even at spoon thick stage of viscosity [8].

In a long-term usage, the thickened liquids have to meet the necessity of adequate water supply according to daily fluid requirement (25-40 ml/kg) [20]. The sufficient water absorption from thickened liquids by Xanthan gum thickeners is confirmed in many studies [21].

Xanthan Gum Compatibility and Consistency

Xanthan gum can be mixed with various types of hot and cold liquids with a pH range of 1.5 – 11, and despite the different conditions of these liquids, Xanthan gum

can alter their rheological properties almost equally. This robust thickening feature of Xanthan gum due to its compatibility with different beverages like hot coffee, cold soda, and tepid milk is a promising advantage for use as a commercial instant thickening agent [22].

It is essential for thickened liquids to have viscosity consistency of in different conditions and over certain time periods. The viscosity of the thickened liquids by Xanthan gum remains almost constant throughout freezing followed by thawing. This viscosity consistency allows patients (or nurses) to prepare thick liquids once daily [23].

Thickened liquids with starch base thickeners are strongly affected by Amylase, one of the saliva's enzymes. Amylase cleavages starch to lesser weight molecules with no thickening characteristic. Xanthan gum is completely resistant to Amylase [24].

Nonetheless, unfortunately Xanthan gum is also resistant to many enzymes of other parts of gastrointestinal tract; hence, the thickened liquids remain intact (without any changes in viscosity, permeability, etc.) until arriving at colon. In spite of the mentioned advantages, this property can cause serious interactions with some drugs. For instance, complete tablets and capsules may not dissolve in Xanthan gel at all, even if they are crashed before adding to Xanthan gel, and therapeutic concentration of drug absorption may be affected due to slow absorption of the trapped drug [25].

Xanthan Gum Palatability

Some patients have to use thickeners to consume beverages for quite a long time – even a life time. So, usually each repeated odor and taste reduces the patients' compliance, especially the unpleasant ones. Food grade Xanthan gum powder is a water-soluble, cream-to-white adhesive powder which can produce almost odorless, tasteless, and transparent thickened water.

However, at contact time, viscous liquids (thickened liquids by both gum and starch base thickeners) make a film layer on tongue which inhibits thirst feeling reduction after drinking. In addition, thickened liquids, especially if containing nutritional fibers, induce satiety. Eventually, thirst feeling maintenance, satiety induction and compromised inclination of patients due to unpleasant slimy texture of the thickened liquids via Xanthan gum lead to low patient compliance and may increase undue dehydration risk [11]. However, Xanthan gum-base thickeners are preferred by patients in comparison with other thickening agents like starch-base ones due to starchy taste, grainy texture and cloudy appearance [11, 12].

Conclusion

Dysphagia is a life-threatening condition with many complications which can cause death. To reduce the burden of dysphagia on patients and society, multidisciplinary management is required. Thickener agents are employed in both diagnosis and management of dysphagia. According to our knowledge, we do not have commercial thickeners in our country and our scientists and practitioners use gelatin instead. Gelatin

has its own problems such as instability on temperature, being melt once put in mouth. Xanthan gum is another agent which has many positive characteristics than gelatin and is available in Iran. We suggest researchers and practitioners to use Xanthan instead of gelatin because of efficacy, compatibility and consistency of Xanthan gum-based thickeners. Moreover, they can supply adequate hydration for patients but satiety induction and thirsty feeling maintenance of thickened liquids by xanthan gum is not satisfactory making the patients not to adhere to them. We should emphasize that this problem is the same for other thickening agents. This unpleasant feature has the potential to propel the patients to dehydration and malnutrition. Also, drug interaction is another critical issue which needs further investigation.

According to all benefits and limitations of Xanthan gum, it seems that it is the best choice for clinical and investigational applications because of the lower risk of complications of dysphagia such as aspiration pneumonia.

Xanthan gum powder is available in Iran and production of a commercial Xanthan-base instant thickener formulation is in progress based on our latest information.

Conflict of Interests: None declared.

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