CE

Tolerability and Product Properties of a Gum-Containing Thickener in Patients With Dysphagia

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Abstract

Purpose: The aim of the study was to determine the gastrointestinal (GI) tolerability of drinks and foods thickened with a gum-containing thickener compared to a starch-based thickener in patients with dysphagia.

Design: A randomized, double-blind, controlled, parallel group study.

Methods: Subjects started with a 3-day run-in period on a starch-based thickener and continued with a 14-day intervention on either the starch-based or gum-containing thickener. GI tolerance parameters were recorded at baseline and for three consecutive days in both weeks. Product properties were studied using a feedback questionnaire from carers.

Findings: Incidence and intensity of GI symptoms was low and not significantly different between groups. Carers indicated that starch-thickened drinks became significantly thinner with time compared to gum-containing thickened drinks ($p = .029$).

Conclusions and Clinical Relevance: No differences in GI tolerance parameters between groups were observed. We hypothesize that use of the gum-containing thickener is preferred to a starch-based thickener due to the stability of its viscosity during consumption.

Key words: Gastrointestinal tolerability; dysphagia; tara gum; humans.

Introduction

Eating and drinking are an important part of life, not only out of necessity but also because they are enjoyable social activities (Ekberg, Hamdy, Woisard, Wuttge-Hannig, & Ortega, 2002). Having dysphagia, defined as a difficulty or inability to swallow, can turn eating and drinking into stressful and embarrassing tasks and over time can even lead to malnutrition, dehydration, aspiration pneumonia, and death (Almirall et al., 2013; Ekberg et al., 2002; Logemann, 1998; Martino et al., 2005; Rofes et al., 2011; Vivanti, Campbell, Suter, Hannan-Jones, & Hulcombe, 2009).

The prevalence of dysphagia is high: It affects 37%–78% of patients who have had a cerebrovascular accident (Martino et al., 2005), up to 82% of patients with Parkinson's disease (Kalf, de Swart, Bloem, & Munneke, 2011), more than 35% of patients with head and neck diseases (García-Peris et al., 2007), between 13% and 57% of individuals with established dementia (Alagiakrishnan, Bhanji, & Kurian, 2013), between 11% and 16% in nonhospitalized elderly, and 55% in unwell older (Roden & Altman, 2013).

Diet modifications such as thickening liquids or modifying the texture of foods in combination with adjustments in posture during swallowing are routinely used to allow safe swallowing (Logemann, 1998; Rofes et al., 2011; Steele et al., 2015; Vivanti et al., 2009). It is generally thought that adjusting food bolus viscosity can improve swallowing by affecting oral and pharyngeal transit times, timing, and duration of upper esophageal sphincter opening and duration of hyoid and laryngeal movement (Dantas & Dodds, 1990; Logemann, 1998) The degree of viscosity modification is based on the swallowing capacity of the individual patient and must be regularly evaluated and adjusted. In many cases, thickeners are used that are mixed with a drink to achieve a target consistency. These commercially available thickeners are either starch- or gum-based (Garcia, Chambers, Matta, & Clark, 2008; Hanson, O'Leary, & Smith, 2012; Vallons, Helmens, & Oudhuis, 2015).

Currently, there are no internationally standardized terminology and definitions for liquid modification (Cichero,

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2013), and various experts and international societies refer to various terminology and definitions. The American Dietetic Association considers four levels: thin liquid, nectar, honey, and spoon thick viscosity (National Dysphagia Diet Task Force, 2002). However, in Australia three levels are defined: mildly thick, moderately thick, and extremely thick (Atherton, Bellis-Smith, Cichero, & Suter, 2007). Viscosities of thickened drinks are dependent on thickener concentration, shear rate, standing time, and temperature (Garcia et al., 2008; Sopade, Halley, Cichero, & Ward, 2007). Furthermore, different types of thickeners show different behavior. It has been reported that starch-thickened drinks do not maintain their viscosity over time, and both an increase and a decrease of viscosity have been shown for different starch-based thickeners over time (O'Leary, Hanson, & Smith, 2010). In addition, drinks thickened with starch appeared to be more sensitive to variations in temperature than drinks thickened with xanthan gum (Garcia et al., 2008). Finally, starch—contrary to gums—is susceptible to the action of salivary amylase. Consequently, drinks thickened with starch may become too thin once in contact with saliva in the cup or in the mouth. This was shown in laboratory tests and studies with healthy volunteers, and the relevance of this problem has been confirmed by speech and language therapists (SLTs; Day & Pell, 2007; Hanson et al., 2012; Vallons, Helmens, et al., 2015; Vallons, Oudhuis, Helmens, & Kistemaker, 2015). Thinning starch-thickened drinks prevents patients from receiving their prescribed consistency, which may have negative consequences for the patient.

In contrast to starch, the breakdown of which already starts in the oral cavity, gums enter the small intestine intact due to their resistance to the action of amylase. Gums are degraded, like all fermentable dietary fibers, by fermenting bacteria in the large intestine. Because of their need for texture modification, patients with dysphagia tend to consume higher amounts of (some of) the ingredients of thickeners than healthy adults. The modified thickener tested in this study is composed of a combination of starch and three gums ([predominantly] tara gum, xanthan gum, and guar gum). Not all starch, but only a part, was replaced by gums, since too high daily dosages of gums might affect gastrointestinal (GI) tolerance. Previous studies have shown that consumption of guar and xanthan gum in amounts varying from 10 to 30 g daily for at least 10 days was well tolerated by healthy subjects (Daly, Tomlin, & Read, 1993; Eastwood, Brydon, & Anderson, 1987; Groop, Aro, Stenman, & Groop, 1993; McIvor, Cummings, & Mendeloff, 1985). Although tara gum has an acceptable daily intake "nonspecified," its GI tolerance has never been tested in humans (Borzelleca, Ladu, Senti, & Egle, 1993). The objective of this study was, therefore, to assess the tolerability of a tara gum-dominated thickener compared to a starch based-thickener in its target population: Patients with dysphagia on an SLT prescribed texture-modified diet. To the best of our knowledge, currently no studies are available which compare the GI tolerability of a gum-containing thickener with a starch-based thickener.

Method

Subjects

This randomized, prospective, double-blind, controlled, parallel group, multicenter study (ClinicalTrials.gov: ISRCTN86521801) was performed in four hospitals in Ireland and the United Kingdom and in four nursing homes and one rehabilitation center in the Netherlands. The study conforms to the ethical guidelines of the Declaration of Helsinki and was approved by the ethics committees of the local sites.

Patients with dysphagia on a thickened diet and living in institutionalized care were included in the study. Patients older than 18 years were included in the study if they presented oropharyngeal dysphagia (i.e., difficulty in safe transfer of a liquid or food bolus from the mouth to the oesophagus) of neurological etiology, confirmed by SLT to be of stable severity, and if they followed a prescribed texture-modified diet regimen for at least 1 week prior to study entry.

Exclusion criteria were as follows: participation in any other study involving investigational products concomitantly or within 2 weeks prior to entry into the study, enteral feeding to >50% of total energy intake, parenteral feeding, acute or terminal illness, Crohn's disease, or undefinable bowel habit. Patients with dementia or Alzheimer's were also excluded. After written consent, patients were allocated to one of the groups using a computerized randomization program. Subjects were randomized in blocks of 2.

Study Design

The test product was a thickening powder for patients with dysphagia containing a combination of starch and gums (gum-containing thickener; Nutricia N.V. Zoetermeer, The Netherlands). The comparison was a starch-based thickening powder for patients with dysphagia (starch-based thickener; Nutricia N.V. Zoetermeer, The Netherlands). The product compositions are shown in Table 1. The gum-containing thickener contained 8.6 g fiber per 100 g powder. The study products were used for thickening drinks and meals in accordance with the subjects' normal thickened

Table 1 Product composition

	Gum-Containing Thickener[a]	Starch-Based Thickener[b]
Contents per can (g)	225.0	225.0
Energy (kcal/100 g)	333.0	360.0
Protein (g/100 g)	0.3	<0.5
Carbohydrate (g/100 g)	82.8	90.0
Fat (g/100 g)	0.1	<0.2
Dietary fiber (g/100 g)	8.6	<0.4
Moisture (ml/100 g)	≤9.0	≤9.0
Sodium (mg/100 g)	154.0	200.0

[a]The gum-containing thickener is composed of the following ingredients: modified starch, maltodextrin, tara gum, xanthan gum, and guar gum.
[b]The starch-containing thickener is composed of modified starch.

diet regimen. After a 3-day run-in (baseline period) in which the patients received their normal thickened diet using the starch-based thickener, they were randomized to continue with the starch-based thickener or to start using the gum-containing thickener for the 2-week intervention period.

Primary endpoints were GI symptoms (intensity and incidence of GI symptoms, stool frequency and consistency, and use of laxatives and enemas). Secondary outcomes were intake of thickening powder and a carer evaluation on the product properties of the powders. Incidence and intensity of GI symptoms using a GI questionnaire, stool frequency and consistency, and intake of thickening powder were monitored daily by the carers for three consecutive days during the baseline period and twice during the intervention period (3 days at the end of each week). During these periods, incidence and intensity of GI symptoms was collected with the subject's assistance, and the use of A4 laminate show cards using a 4-point scale (0 = *absent*, 1 = *mild*, 2 = *moderate*, 3 = *severe*). These data were used to calculate the total GI score (sum of scores for the 7 GI symptoms, calculated as average of the 3 days). GI symptoms scored were nausea, vomiting, diarrhea, constipation, abdominal distension, burping, and flatulence. Information on stool consistency was also collected with the subject's assistance and the use of A4 laminate show cards using the 7-point Bristol Stool Form Scale (O'Donnell, Virjee, & Heaton, 1990; Riegler & Esposito, 2001). The use of laxatives and enemas and the occurrence of adverse events (AEs) and serious adverse events (SAEs) were monitored on a daily base. At the end of the study, the investigator asked the carers to complete a product evaluation questionnaire. Carers scored the following product properties on a 5-point scale questionnaire (ranging from excellent, good, average, poor to very poor): dispersibility of the powder, ease of preparation of thickened drinks/meals, satisfaction with thickening behavior, and appearance of thickened drinks. Consumption induced change in thickness was scored on another 5-point scale (became much thicker, became slightly thicker, didn't change, became slightly thinner, became much thinner).

Statistical Analysis

Subject characteristics at initial assessment were analyzed for differences between groups using Fisher's exact test except for age, for which one-way ANOVA was used. Means, standard deviations, medians, and percentiles were calculated. Intake of thickening powder, stool frequency, stool consistency, total GI score, and carer evaluations were analyzed using Student's *t* test. The Mann–Whitney test was used when the assumption for *t* test, normally distributed data, was not met. Incidence and intensity of GI symptoms and use of laxatives and enemas were analyzed using Fisher's exact test. p values of $<.05$ were considered statistically significant. For statistical analysis, the results of the ITT (randomized) population were used. Statistical analysis was performed using SPSS version 12.0.1 for Windows.

Results

Patients

Thirty-two patients were included, of which one was not randomized because of noncompliance with the study protocol during the baseline period (Figure 1). Four patients did not complete the study: one in the gum-containing thickener group and three in the starch-based thickener group. One of the patients in the starch-based thickener group died after having developed acute silent abdomen. Three patients did not fully comply with the protocol: two in the gum-containing thickener group and one in the starch-based thickener group.

Table 2 summarizes the demographics and characteristics of randomized patients. At initial assessment, there were no significant differences between groups in any of the patient characteristics. Age ranged from 29 to 91 years. The majority of patients received Stage 1 thickened drinks (defined as a viscosity of 450 ± 200 mPa s at a shear rate of 50 1/s at 20°C).[1] One patient received Stage 3 thickened (defined as 3,000 ± 1,000 mPa s at a shear rate of 50 1/s at 20°C), and three patients received texture-modified meals only.

[1]Note: Viscosity is a measure of the resistance of a fluid to gradual deformation by shear stress. For liquids, it corresponds to the informal concept of "thickness," for instance, honey has a higher viscosity than water. The unit of viscosity is miliPascal second (mPa s). The shear rate is the rate at which a progressive shearing deformation is applied, and this may affect the viscosity, like temperature. Therefore, both temperature and shear rate are mentioned when describing a viscosity. The unit of shear rate is reciprocal seconds (1/s) or s^{-1}.

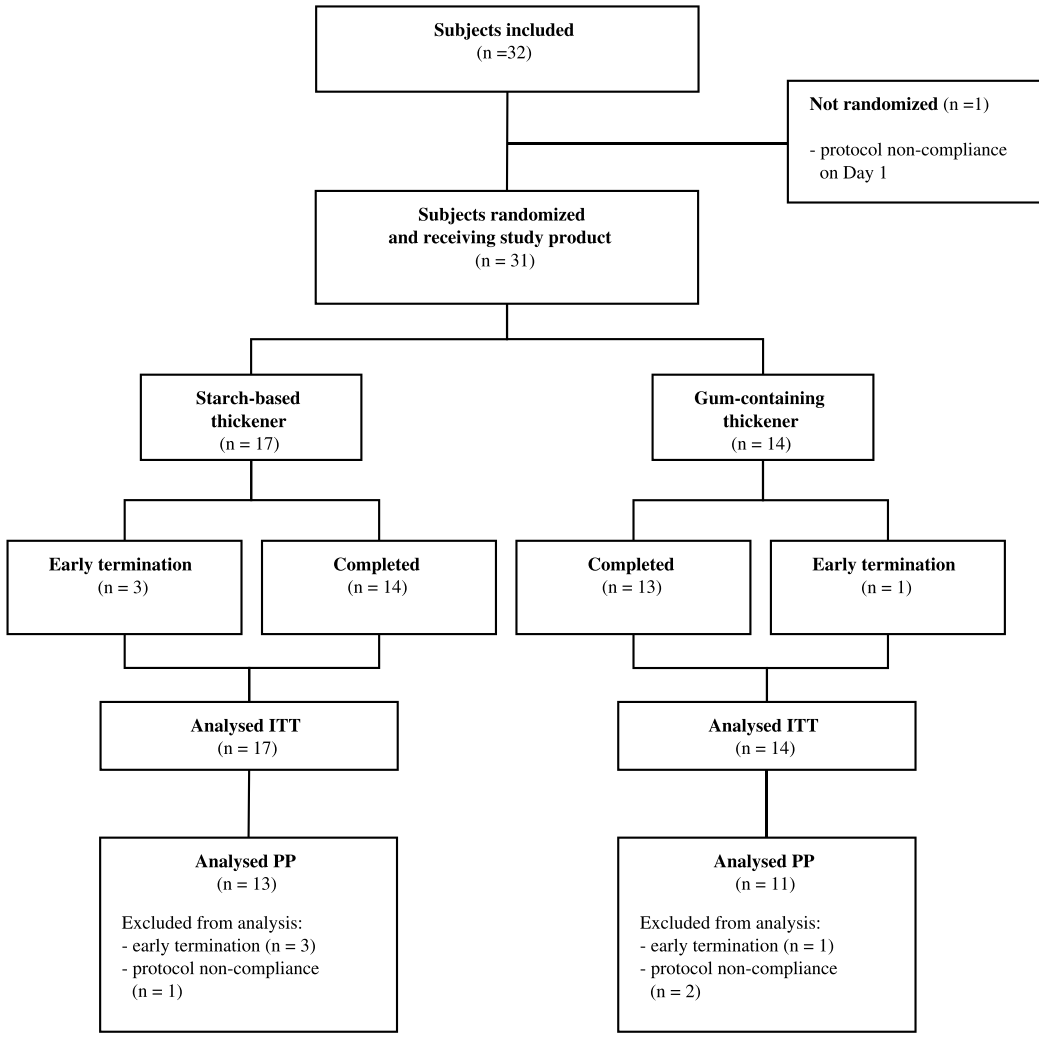

Figure 1. CONSORT flow diagram showing the number of patients included, randomized, and completed. ITT = intention to treat; PP = per protocol.

Average Consumption of Thickening Powder

No significant difference in mean daily product intake was found between groups at any of the measured time points (baseline, Week 1, and Week 2; Table 3). The average consumption in the three study periods ranged from 25.5 to 29.4 g daily in the gum-containing thickener group and from 23.5 to 26.6 in the starch-based thickener group. In the baseline period, highest consumption of thickener was observed in subjects using both thickened drinks and meals (average: 36.8 g powder per day, maximum: 57.7 g/day in the gum-containing thickener group and average: 30.8 g powder per day, maximum: 51.5 g/day in the starch-based thickener group; 3-day mean). Lowest average consumption was observed in subjects receiving only thickened meals and no thickened drinks (average: 18.9 g powder per day, maximum: 18.9 g/day in the gum-containing thickener group and average: 16.1 g powder per day, maximum: 18.3 g/day in the starch-based thickener group). Subjects receiving only thickened drinks and no thickened meals consumed an average of 21.1 g powder per day, maximum 34.0 g/day in the gum-containing thickener group, and an average of 25.5 g powder per day, maximum 42.0 g/day in the starch-based thickener group.

Stool Regularity

No significant differences between the groups were detected in stool frequency, stool consistency, and use of laxatives and enemas. Median stool frequency was 0.8 at baseline, 1.0 in Week 1, and 1.0 in Week 2 for the gum-containing thickener group. For the starch-based thickener group, these numbers were 1.0, 1.0, and 0.8, respectively (Table 3). Average stool consistency score (Bristol Stool Form Scale) was 4.3 for both Weeks 1 and 2 in the gum-containing thickener group, whereas in the starch-based thickener groups, the average scores were 4.1 and 4.4, respectively. As shown in Table 3, the use of laxatives in the gum-containing thickener group was 79% in Week 1

Table 2 Demographics and characteristics of randomized patients

	Gum-Containing Thickener	Starch-Based Thickener	p[a]
Patients (*n*)	14	17	
Age (years), mean ± *SD*	69.4 ± 17.4	66.4 ± 17.8	.640[b]
Gender			.722
Male	8 (57%)	8 (47%)	
Female	6 (43%)	9 (53%)	
Primary diagnosis			.45
Stroke	10 (71%)	8 (47%)	
Parkinson	0	2 (12%)	
Other neurological disorder	4 (29%)	6 (35%)	
Other	0	1 (6%)	
Thickened fluid regimen			.324
Syrup (Stage 1)	9 (64%)	8 (47%)	
Custard (Stage 2)	3 (21%)	7 (41%)	
Pudding (Stage 3)	1 (7%)	0	
Texture-modified meals only	1 (7%)	2 (12%)	

Data are given in *n* (%) unless otherwise indicated.
[a]Fisher's exact test was used for analysis of statistical difference between groups, except for age.
[b]One-way ANOVA was used for analysis of statistical difference between groups.

and 75% in Week 2 and 65% and 64%, respectively, in the starch-based thickener group. One subject in the gum-containing thickener group received enemas during baseline and Week 1 and stopped using enemas in Week 2 (data not shown).

Incidence and Intensity of GI Symptoms

There was no significant difference in incidence and intensity of GI symptoms between groups (data not shown). Furthermore, incidence and intensity of GI symptoms was low in both groups. The median of the total GI score was zero in both study groups and during the three different time periods, except for a value of 0.2 for the baseline period of the gum-containing thickener group. No significant difference was found between groups at the different time points. Maximum total GI score was 3.7, which represented a patient having one severe and one mild symptom (providing a score of 3 and 1, respectively, resulting in a total score of 4) or having two moderate symptoms (providing twice a score of 2, resulting in a total score of 4).

(Serious) Adverse Events

One SAE was reported during the study. One subject in the starch-based thickener group developed acute silent abdomen with lactic acidosis, resulting in death. The SAE was not related to the study product. For the total study, 11 AEs were reported, three in the gum-containing thickener group[2] (with two subjects) and eight in the starch-based thickener group[3] (with six subjects). This was not significantly different between groups. Two AEs occurred during baseline. During intervention, two AEs occurred in the gum-containing thickener group (with two subjects) and seven in the starch-based thickener group (with five subjects). In the starch-based thickener group, one AE (vomiting) was evaluated as possibly related to the study product. Another AE in this group (diarrhea) was assessed as probably not related. All other AEs were assessed as not related.

Carer Product Evaluation

A questionnaire was used to evaluate five aspects concerning thickener properties, and this questionnaire was filled in by 26 carers. For four aspects (dispersibility of the powder, ease of preparation of thickened drinks/meals, satisfaction with thickening behavior, appearance of thickened drinks), no significant difference was found between groups. An example of this is presented in Figure 2, which shows the feedback on the question whether the carers were satisfied with the thickening behavior of the powders (p = .790). A significant difference was found between the gum-containing thickener and the starch-based thickener for consumption induced change in thickness (Figure 3): The starch-based thickener had more scores on "became slightly thinner" or "did not change," whereas the gum-containing thickener had more scores on "became slightly thicker" or "became much thicker" (p = .029).

Results Summary

This study compared the tolerability of a thickener product containing a combination of starch and gums with that of a thickener product composed only of starch in patients with dysphagia with a prescription for a texture-modified diet. The patients had an average age of 68 years and a primary diagnosis of stroke, Huntington's disease, or Parkinson's disease. Patients with dementia or Alzheimer's disease were excluded. GI symptoms (nausea, vomiting, diarrhea, constipation, abdominal distension, burping, and flatulence) did occur in both groups, but only in a few subjects and mostly to a mild degree, as indicated by the low median total GI score. Average stool frequency was approximately 1 defecation per day, and for average stool consistency a score of 4 was reported, both indicating a regular stool pattern. No significant differences were found

[2]Difficulty with micturition (after removal of a urinary catheter), mild irritating cough, and choking (which was highly probably related to aspiration; the choking was noted on medication, which was not appropriately thickened).
[3]Regaining pain sensation from fractured ankle, O_2 saturation to 85% (not related to aspiration), shortness of breath (not related to aspiration), dry eyes, vomiting (following exertion after having a meal), cold, diarrhea, and urinary tract infection.

Table 3 Comparison of outcome parameters

	Gum-Containing Thickener	Starch-Based Thickener	p^a Gum-Containing Thickener vs. Starch-Based Thickener
Median total GI score (average score (min–max))			
Baseline	0.2 (0.0–3.7)	0.0 (0.0–2.3)	.633
Week 1	0.0 (0.0–3.0)	0.0 (0.0–2.5)	.646
Week 2	0.0 (0.0–2.3)	0.0 (0.0–3.7)	.909
Median stool frequency (*n* per day (min–max))			
Baseline	0.8 (0.3–2.0)	1.0 (0.0–1.7)	.685
Week 1	1.0 (0.3–1.3)	1.0 (0.0–1.5)	1.000
Week 2	1.0 (0.3–1.7)	0.8 (0.0–3.0)	.679
Stool consistency (BSF Scale)			
Baseline	4.4 (1.5)	4.3 (1.2)	.764
Week 1	4.3 (1.1)	4.1 (1.4)	.579
Week 2	4.3 (1.3)	4.4 (1.3)	.974
Use of laxatives (%)			
Baseline	71	71	1.000
Week 1	79	65	.456
Week 2	75	64	.683
Other endpoints			
Product intake (g/day)			
Baseline	25.4 (13.4)	25.3 (11.7)	.980
Week 1	29.4 (14.4)	26.6 (11.5)	.558
Week 2	26.0 (11.6)	23.5 (11.4)	.586

Data are given in mean ± *SD* unless otherwise indicated. GI = gastrointestinal; BSF Scale = Bristol Stool Form Scale.
[a]Student's *t* test (stool consistency, product intake) or the Mann–Whitney test (stool frequency, total GI score) was used to calculate *p* values. For use of laxatives, the Fisher's exact test was used.

for these parameters between groups. These results indicate that a gum-containing thickening powder is as well tolerated as a starch-based thickener.

Discussion

Previous studies with guar gum and xanthan gum have shown that consumption of these gums in amounts varying from 10 to 30 g daily for at least 10 days was well tolerated and caused no adverse dietary or physiological effects (Daly et al., 1993, Eastwood et al., 1987, Groop et al., 1993, McIvor et al., 1985). To the best of our knowledge, no tolerance data on tara gum are available, whereas the gum-containing thickener in this study is tara gum dominated (content of 7.6 g per 100 g thickening powder). Three-day mean values for consumption of the gum-containing powder were 29.4 g/day in Week 1 and 26.0 g/day in Week 2, which corresponds to 2.2 and 2.0 g tara gum per day, respectively. Our data, thus, indicate that this average daily consumption of tara gum, in combination with xanthan gum and guar gum and starch, is as well tolerated as starch alone.

In this study, regular laxative use was reported between 65% and 80% of the subjects, which is quite high, but not surprising in nursing home residents with low mobility (Marfil, Davies, & Dettmar, 2005; Wisten & Messner, 2005). In the study of Sturtzel et al. among 30 frail inhabitants of a long-term care facility, it was shown that oat fibers supplementation for 12 weeks allowed discontinuation of laxative use by 59%. Subjects in the active group consumed 7–8 g of fiber per day mixed in the common diet (Sturtzel, Mikulits, Gisinger, & Elmadfa, 2009). In the current study, no effect of the use of the new thickening powder on use of laxatives and enemas was found. This could be due to the relatively small amount of additional fiber consumed (29.4 g of thickening powder on average per day in Week 1 and 26.0 g on average in Week 2, which corresponds to 2.5 and 2.2 g of dietary fiber, respectively) and the duration of the intervention. Fiber recommendations for healthy populations state that current

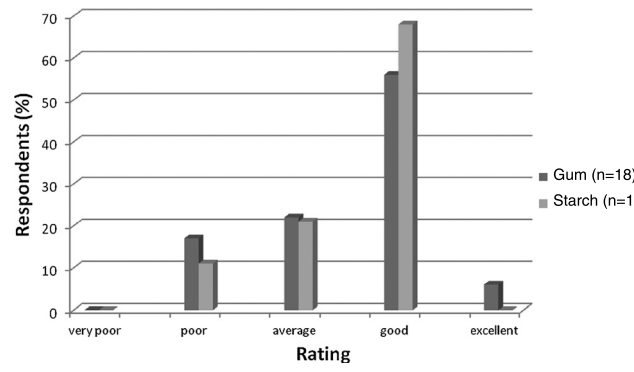

Figure 2. No significant difference between the gum-containing thickener (Gum) and the starch-based thickener (Starch) on the thickening behavior (p = .790) was found. The question asked to the carer was: "How satisfied are you with the thickening behavior of the powder?"

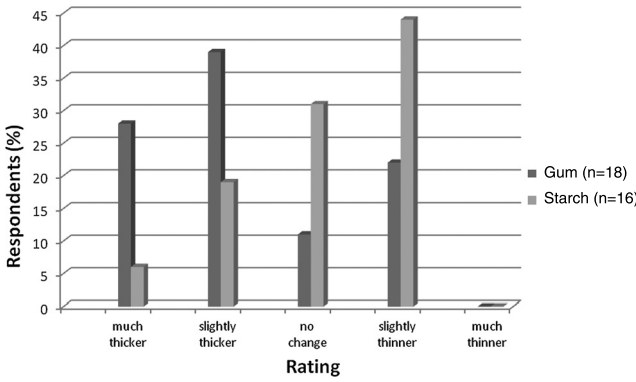

Figure 3. Carers reported that drinks thickened with starch (Starch) became significantly thinner with time compared to drinks thickened with the gum-containing thickener (Gum; $p = .029$). The question asked to the carer was: "Does the consistency of thickened drinks change with time?"

fiber intakes are inadequate and should be increased. Guidelines from EFSA and the United States recommend a daily fiber intake of approximately 25 and 30 g respectively for adults (EFSA Panel on Dietetic Products, Nutrition and Allergies, 2010; U.S. Department of Agriculture and U.S. Department of Health and Human Services 2010). It might be worth determining the fiber intake of the patients in this study and, if it is too low, supplementing the diet with more dietary fiber.

A questionnaire was used to ask the carers' opinion on the product properties of the two thickening powders. For most questions on thickener use, carer feedback did not reach statistical significance. Carers reported, however, that drinks thickened with the starch-based thickener became thinner with time compared to drinks thickened with the gum-containing thickener. In their paper, Day and Pell (2007) mention two problems that starch-based thickeners pose: (i) these are prone to break down when in contact with saliva, which results in the patient not receiving the prescribed consistency, and (ii) these thicken on standing, resulting in an unpalatable product (Day & Pell, 2007). We hypothesize that contamination with saliva caused a thinning effect for drinks thickened with starch, whereas for the gum-containing thickener this was not observed. This hypothesis is supported by the proven amylase resistance features of the gum-containing thickeners (Vallons, Helmens, et al., 2015; Vallons, Oudhuis, et al., 2015).

The present study has some limitations: (a) A relatively high number of subjects (between 65% and 80%) used laxatives regularly. Although the use of laxatives was relatively stable over time, this might have influenced the incidence and intensity of GI tolerance symptoms and stool frequency/consistency. (b) The data on incidence and intensity of GI symptoms were collected from the patient's perspective using score cards having a 4-point scale and were, therefore, a subjective measure. However, by also measuring these scores at baseline, we tried to account for interindividual differences in evaluation of symptoms. (c) Thickening powder intake observed in this study was lower than a theoretically expected maximum intake for patients in need of Stage 3 thickened drinks (up to 100 g thickening powder/day). However, the study was confined to clinical practice, with Stages 1 and 2 thickened drinks being the most commonly prescribed regimens. (d) Product properties were subjectively and retrospectively evaluated by the carers in each center via a questionnaire after the last patient finished the study in their center. The questionnaires did not distinguish between types of drinks thickened.

As described in the Introduction, in contrast to gum-containing thickeners, starch-based thickeners have some limitation with respect to stability over time, temperature sensitivity, and susceptibility to the action of amylase, which results in thinning of the product once in contact with saliva. Furthermore, starch-based thickened drinks are in general not well accepted by patients (Garcia, Chambers, & Molander, 2005). They imparted a starchy flavor and grainy texture (Lotong, Chun, Chambers, & Garcia, 2003; Matta, Chambers, Mertz Garcia, & McGowan Helverson, 2006).

On the other hand, as shown in the current study, no significant differences between a gum-containing thickener compared to a fully starch-based thickener were found for GI symptoms, stool frequency and consistency, or use of laxatives. There were no safety issues based on reports of AEs. In addition, carers did not report differences in ease of use between the two thickeners. Therefore, we conclude that the use of the thickener containing a combination of starch and gums (tara, xanthan, and guar gum)

Key Practice Points

- For the management of dysphagia both gum-containing thickeners (amylase resistant) and starch-based thickeners are available.
- Starch-based thickeners have some limitations in taste, viscosity stability and temperature sensitivity as compared to gum-containing thickeners. Furthermore, they are, in contrast to gums, susceptible to the action of amylase, which results in thinning of thickened fluids once in contact with saliva.
- In the current study, incidence and intensity of gastrointestinal symptoms was low and not significantly different between dysphagia patients using gum-containing thickener or starch-based thickener.
- The use of the gum-containing, amylase resistant thickener is therefore preferred relative to a starch-based thickener for patients with dysphagia.

in the management of dysphagia is preferred over the use of a pure starch-based thickener.

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