Management of Swallowing Disorders using Thickened Drinks

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Introduction
An impaired ability to eat or drink can significantly affect health and quality of life. In the UK, millions are affected by this ‘dysphagia’, from children with cerebral palsy, to 20 per cent of the adult primary care population, and to over 50 per cent of elderly care home residents.

The preference is to maintain normal feeding, orally where possible, and this is often achieved by texture modification of the individual’s diet, including thickened drinks. This strategy can be very successful in avoiding some of the health risks associated with dysphagia, and is an interesting illustration of the importance of ‘consistency’ of diet.

This article describes how and why thickened drinks can help in managing dysphagia, outlines some of the concerns, and points the way to getting the most out of that management strategy.

Dysphagia
Swallowing is an almost automatic action for most of us, but each swallow depends on the co-ordinated sensing, timing and motion of multiple structures through the oral, pharyngeal, laryngeal, and oesophageal stages sequentially. The term dysphagia describes any impairment to the safety or quality of eating or drinking through malfunction in any of those successive stages. Forms of dysphagia are commonly observed following stroke, head and neck surgery, or as a consequence of Parkinson’s disease, Alzheimer’s disease, or cerebral palsy, and may occur at any age.

Health and quality of life
An immediate health risk is aspiration (food or drink entering the airways and lungs). This happens to many healthy people on occasion – ‘going down the wrong way’. However, it may occur more regularly with dysphagia, and the individual may lack the sensory reflex or strength to clear their airways through coughing. In such situations, bacterial infection (aspiration pneumonia) can be serious and fatal. Further health risks arise from malnutrition and dehydration through reduced consumption, which may be involuntary or result from reduced preference for a restricted diet. Dysphagia affects quality of life since many of the most significant social occasions involve shared meals and drinks.
The importance of being thick

While the impact of dysphagia is potentially serious, it is often managed very successfully by techniques including controlling the consistency of foods and drinks. Typically, hard foods are excluded, and those requiring substantial chewing. Thin liquids (water, tea) are often problematic too because they flow quickly and some dysphagic individuals find it hard to control a sipped bolus, which may spill, or be aspirated into the lungs. The swallowing process is summarised from a drink’s point of view in Figure 1. At each stage the flow motion of the fluid depends on the forces driving it, and on the characteristics of the fluid.

Viscosity
‘Viscosity’ describes a fluid’s physical resistance to flowing. A low-viscosity liquid (e.g. water) will flow very easily and quickly, whereas a higher-viscosity liquid (e.g. a thick milkshake) would flow more slowly and, if drunk through a straw, would require a greater pressure difference (suction) to achieve the same flow rate as water. Referring to Figure 1, within the mouth, a high-viscosity liquid would flow slowly, giving more chance to control and position a bolus ready to be swallowed. However, the viscosity should not be too high, since it needs to flow quickly past the larynx, and that should not require excessive muscular pressure. The viscosity of any liquid can be calculated from the ratio of how much pressure (‘shear stress’) is required to result in a certain rate of flow. Since viscosity is pressure divided by rate, viscosity corresponds to the slopes of the lines labelled in Figure 2. Generally, thick drinks (whether naturally thick, or texture modified) have an interesting non-linear relationship. If we observe a fruit smoothie, a thick liquid, in a glass, it would have a high apparent viscosity since it doesn’t flow very fast when we tip the glass. In fact, a very thick smoothie could be taken with a spoon; it wouldn’t flow off the spoon so it appears to be very high viscosity indeed (even ‘solid’). However, you could still swallow the smoothie easily, it would flow quickly through the pharynx without much additional pressure needed. That is shown by the flattening out of the curve in Figure 2. During swallowing, the apparent viscosity is low (a shallow slope). In contrast, honey is a ‘Newtonian fluid’, having a constant viscosity – drinking a full glass of honey would not

Figure 1: Summary of the Swallowing Process from the Drink’s Point of View

- Liquid in a cup flows towards the lips due to gravity.
- A small volume of liquid is taken into the mouth, the flow through the lips results from fine control of the pressure within the mouth (a slight suction) and motion of the tongue to control the oral cavity.
- The lips seal, closing off a volume of liquid.
- Finely controlled motions are required to manipulate the liquid within the mouth, continually sensing the position and containing it into one bolus on the tongue surface.
- The tongue forcibly propels the bolus backwards through the pharynx and downwards. The flow is not purely gravity driven but is driven by a squeeze between the tongue and palate.
- Meanwhile, muscular motions elevate the soft palate (to seal off the nasal cavity) and the larynx, which becomes covered and protected by the epiglottis prior to the passage of the bolus.
- Past the larynx, the upper oesophageal sphincter opens and fluid flows through the oesophagus under the action of gravity and a muscular peristaltic compression wave.

Figure 2: Flow Curves for Thick Fluids

- Fruit Smoothie
- Pourable Honey

Figure 3: Microscopy Images of Maize Starch Grains Added to Water

- Immediately after immersion
- Time = 4 seconds
- Time = 8 seconds
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be easy!

Thickened drinks in practice

A speech and language therapist may prescribe a texture modified diet after assessing an individual’s swallowing. Dietary products can then be selected, and can be modified to fit the prescription. Meat or vegetables can be pureed, and watery liquids can be thickened. Instant food thickeners are very widely used on all kinds of drinks and can be an extremely valuable and versatile tool. They can be used in institutional kitchens, at home, or by the bedside. Figure 3 shows the process of thickening when starch powder is added to a watery liquid: the grains swell and partly dissolve.

The first thickeners produced for dysphagia applications (around 20 years ago) were starch-based, comprised of modified maize starch granules with maltodextrin to aid mixing. Since then, a range of thickening powders and gels have become available, using various combinations of starch, gums and stabilisers – e.g. xanthan gum, guar gum, carrageenan. These can create products with flow properties which may be useful in managing swallowing disorders. For example, gum-thickened drinks have some jelly-like properties, useful for maintaining a cohesive bolus, which does not flow quickly under gravity alone but can be made to flow quickly with a small additional force. Starch, on the other hand, is very easily digested and produces a thickened liquid with similar flow properties to conventional foods and drinks, e.g. soup, fruit smoothies, or purées.

How thick is thick?

By varying the powder to liquid ratio, one can produce drinks at any level of thickness. Mixing instructions are provided on the labels of thickeners to promote consistent results. However, this subtitle refers to a study which objectively measured mealtime fluids presented to clients in 10 different hospitals and found a large variation in viscosity. Drinks must be prepared with care since several factors affect the resulting properties.

Sources of variation in practice

The amount of powder contained within a measurement scoop can vary by up to 20 per cent, partly due to packing/settling of the powder. The resulting viscosity also depends on the drink to be thickened, even if drinks have apparently the same viscosity to start with, e.g. apple juice vs. white wine. Figure 3 shows that starch grains absorb water very quickly. The mixture thickens over a time-frame of around five minutes and manufacturers recommend a wait period after mixing. We studied liquids over three hour periods, and while there was some continual increase in thickening, it was the repeated stirring of the drink which produced a more significant increase in viscosity.

Saliva may affect thickened drinks since amylase is known to break down starch. In a controlled study, when saliva was added to a beaker of thickened water, its viscosity was reduced to less than one per cent of its original value after 10-15 minutes. However, the reaction is dependent on pH, and for many popular drinks having a pH of 3.6 or lower viscosity was not significantly affected.10

Standardisation

Pre-thickened products

There is a wide range of oral nutritional supplements available, having well-defined nutritional characteristics. These pre-packaged products provide an opportunity to ensure consistent flow properties too. New thickened supplements have been created to have specific viscosity profiles (e.g. matched to barium fluids used for diagnosis).

Descriptive vs. quantitative standards

In the UK, the consistency of drinks for management of dysphagia is classified by the National Descriptors document,1 produced by the Royal College of Speech and Language Therapists with the British Dietetic Association. These descriptive guidelines aim to provide a means to classify fluid consistency into three stages of thickness, based on their appearance. However since the evaluation is subjective, the interpretation is known to vary between practitioners. ‘How thick is thick?’ Some countries use viscosity measures to classify thickness (e.g. USA, Canada, Australia) but for reasons illustrated by Figure 2, a numerical value of ‘viscosity’ can only describe thickened fluid behaviour at one particular rate of flow. A further limitation is the lack of an objective viscosity measurement tool which is practical for universal use outside laboratories or industrial kitchens. To address these issues, an International Dysphagia Diet Standardisation Initiative11 has recently begun, with aims of identifying best practise and means of standardising texture modification internationally, to get the most from this promising technique.

Conclusions

The swallowing process depends on the mechanical properties of the food or drink being consumed. When there are problems with swallowing (dysphagia), texture modification of diet is a tool which can be widely used, and is inexpensive and very flexible. The potential benefits are enormous for patient safety, by providing control of the flow of liquids during swallowing, and for wellbeing and quality of life by enabling oral consumption of a varied, appealing and nutritious diet. There are challenges in ensuring reliability of diet consistency, and further research is required to better-understand the relationships between swallowing and consistency. However, the new international standardisation initiative hopes to bring together scientists, clinicians and industry professionals to bring together scientists, clinicians and industry professionals to work toward standardising texture across different countries.

References: