UNIVERSIDADE VILA VELHA - ES

PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS FARMACÊUTICAS

THICKENERS FOR DYSPHAGIA MANAGEMENT: professional knowledge, standardization and new product

ALESSANDRA SALLES MACHADO

VILA VELHA

DEZEMBRO, 2019

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Tese apresentada a Universidade Vila Velha, como pré-requisito do Programa de Pós-Graduação em Ciências Farmacêuticas, para a obtenção do grau de Doutora em Ciências Farmacêuticas.

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Banca Examinadora:

Profa. Dra. Vinicia Campana Biancardi (Auburn University)

Profa. Dra. Michelle Ferreira Guimarães (AC Camargo Hospital)

Profa. Dra. Girlândia Alexandre Brasil (Universidade Vila Velha)

Profa. Dra. Denise Coutinho Endringer (Universidade Vila Velha)

Orientadora

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RESUMO

MACHADO, ALESSANDRA SALLES, D.Sc, Universidade Vila Velha – ES, Dezembro de 2019. **THICKENERS FOR DYSPHAGIA MANAGEMENT: professional knowledge, standardization and new product.** Orientadora: Denise Coutinho Endringer.

Os objetivos desta tese incluem investigar indicações de alimentos considerados ideais pelos fonoaudiólogos para auxiliar pacientes com disfagia orofaríngea (DO) e compreender suas preocupações com a qualidade da alimentação; investigar seu conhecimento sobre textura, viscosidade, temperatura, sabor e umidade que influenciam os padrões de deglutição; verificar sua capacidade de classificar e nomear diferentes consistências e comparar os resultados com a Dysphagia Diet Standardization Initiative (IDDSI); analisar sete espessantes comerciais em termos de composição, terminologia, instruções de preparação, valores nutricionais e viscosidade; e desenvolver um espessante alimentar para o manejo de DO a partir da pectina extraída do albedo de frutas cítricas: *Citrus sinensis* *e Citrus lemon*. Os fonoaudiólogos priorizam a manutenção da saúde e segurança dos pacientes disfágicos, sem considerar o prazer alimentar e as preferências individuais. Demonstraram conhecimento reduzido sobre as características dos alimentos, com melhores valores nas variáveis textura e consistência do que em temperatura, sabor e umidade. Os profissionais foram assertivos na classificação da progressão das bebidas mas apresentaram uso reduzido de IDDSI e grande diversidade de terminologias. Os espessantes comerciais demonstraram diferenças nos componentes, terminologia empregada, instruções de preparação e quantidades recomendadas. Considerando o desenvolvimento de um produto à base de pectina, as formulações contendo pelo menos uma das duas pectinas foram mais estáveis do que as amostras contendo xantana ou espessante comercial. Pectinas de *Citrus sinensis* e *Citrus lemon* podem ser úteis para alcançar a estabilidade desejada de espessantes comerciais para o tratamento da disfagia, como alternativas viáveis aos espessantes comerciais que contêm goma xantana.

Palavras-chave: Desordens da deglutição. Textura modificada, Disfagia, Comida e bebidas; Espessantes, Pectina, *Citrus*.

ABSTRACT

MACHADO, ALESSANDRA SALLES, D.Sc, Universidade Vila Velha – ES, Dezembro de 2019. **THICKENERS FOR DYSPHAGIA MANAGEMENT: professional knowledge, standardization and new product.** Orientadora: Denise Coutinho Endringer.

The goals of this thesis include to disclose indications of foods considered ideal by speech therapists for aiding patients with oropharyngeal dysphagia (OD) to better understand their feeding quality concerns; to investigate their knowledge about texture, viscosity, temperature, taste and moisture influence swallowing patterns; to verify their ability to identify, sort, and nominate different consistencies and to compare the results with the terms proposed by the Dysphagia Diet Standardization Initiative (IDDSI); to analyze seven commercial thickeners in terms of composition, employed terminology, preparation instructions, nutrition values and viscosity; and to develop a food thickener for the management of OD from the pectin extracted from the albedo of citrus fruits: *Citrus sinensis* and *Citrus lemon*. Speech therapists prioritize maintenance of health and food safety for dysphagic patients, not regarding eating pleasure and individual preferences when selecting food in OD rehabilitation. They demonstrated reduced knowledge about the characteristics of foods, with better values in the variables texture and consistency than in the variables temperature, taste and moisture. The professionals were assertive in sorting the progression of beverages. However, results indicate reduced use of IDDSI and great diversity of terminologies. Commercial thickeners demonstrated differences in components**,** employed terminology, preparation instructions and recommended amounts. Considering the development of a based-pectin product for dysphagia management, formulations containing at least one of the two pectins were more stable than the samples containing only xanthan or commercial thickener. *Citrus sinensis* and *Citrus lemon* pectins can be useful in reaching the desired stability of commercial thickeners for dysphagia management, as viable alternatives to commercial thickeners containing xanthan gum.

Keywords: Deglutition Disorders; Texture Modification; Dysphagia, Food and Beverages; Thickeners, Pectin, *Citrus*.

CHAPTER 1

INTRODUCTION

1 INTRODUCTION

Food intake is essential for survival, to maintain life, and to allow proper hydration and nutrition. Besides, it is related to pleasure and represents great satisfaction in daily life (1). As a potential source of comfort and general well-being, the eating process phases includes expectation, consumption, and satiety (2). Responses to a meal, including the sensory experiences, comprise some sequences of events, not only before and during food ingestion but also after meal completion in postprandial period (3). Under normal conditions, feeding is associated with a pleasant sensory experience, involving sensations related to homeostasis, satiety and fullness, with a hedonic dimension (4, 5). Food intake and its associated pleasure can be affected or interrupted by certain medical conditions when the normal progression of food through the digestive tract is affected (6).

Swallowing is a complex mechanism that occurs successively and automatically and transports food bolus from the mouth to the stomach preventing the entry of substances into the airway (6). Any characteristic that hinders swallowing safely and efficiently is classified as dysphagia, recognized by the World Health Organization within symptoms involving the digestive system (7, 8). Dysphagia is defined as "a swallowing disorder with specific symptoms and signs, characterized by changes in any phase or between phases of the swallowing dynamics of congenital or acquired origin, and may cause pulmonary, nutritional and social damage" (12). Dysphagia symptoms occur due to an underlying disease or aging (6, 9-11). Its systematic study began in the 1980s and evolved significantly, however, most cases of dysphagia is under diagnosed (9, 13). The difficulty in taking food and liquids reaches about 8% of the world population. Neurogenic oropharyngeal dysphagia (NOD) incidence varies from 15 to 84% (7, 14-16). Oropharyngeal dysphagia (OD) may be permanent or transitory (17), neurological, aging, or structural based (18, 19. The risk factors for OD development are related to compromised neuromotor control of swallowing biomechanics due to use of medications, tracheostomy, previous orotracheal intubation, head and neck surgeries, and neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease, stroke and traumatic brain injury (6, 9, 10 (8). In older adults, impairment in swallowing occurs as the result of changes in anatomy and physiology of head and neck, muscle loss (sarcopenia), reduced functional reserve, and the onset of age-related illness (19). With the aging of the world population, health professionals and researchers must be aware of this disorder, its incidence, and its importance.

Dysphagia often leads to severe consequences such as suffocation, aspiration, pulmonary alterations, nutritional deficiencies, significant weight loss, dehydration, and mortality (6, 8, 9, 11, 20-22). It is likely to decrease eating pleasure, social interaction, and quality of life (6, 8, 20-24).

1.1 Dysphagia rehabilitation

For the effective rehabilitation of dysphagia, it is necessary to know the normal mechanism of swallowing and its respective phases.

The stages of swallow are oral preparation, oral stage, pharyngeal stage and the esophageal stage. During oral preparation the food goes through chewing and mixing with saliva. Sensory receptors perceive the viscosity of the bolus regarding the need for additional preparation of the bolus until the ideal consistency is reached. In oral stage the bolus is propelled through the mouth by the oral tongue valve. The amount of pressure needed during a swallow increases sequentially as the bolus becomes thicker. Pharyngeal and esophageal stages lead the bolus through the pharynx, the esophagus and into the stomach. A number of valves are involved to prevent food from entering the airway. In the larynx (epiglottis and aryepiglottic folds; the false vocal folds and arytenoid cartilages; and the true vocal folds. There is normal variability in the swallow mechanism and understanding these variations could lead to better treatment of patients with dysphagia. (17).

Oropharyngeal dysphagia is a multifactorial condition, which requires a multidisciplinary management approach (25). Speech therapists are responsible for selecting aspects of the rehabilitation program to improve swallowing pathophysiology, guide caregivers and patients and promote changes in the diet offered, to guarantee functional oral diet while increasing the quality of life by establishing safe, efficient and pleasurable oral intake (10, 13, 18, 25-28). Rehabilitation includes direct therapy using food supply and indirect treatment, performing a sensorimotor exercise, maneuvers, postural changes (13, 18, 25) and diet modification specific for each patient (18, 26, 27, 29, 30).

However, OD patients can have impacted quality of life due to the use of modified foods (25, 31). Tests comparing the quality of life indices in individuals with and without OD indicated more satisfaction in general health and vitality for individuals presenting an intact eating process (24). The feeding process involves much more than the caloric intake. It includes features such as appearance, flavor, and consistency of food (32). The process of choosing food is not an easy task. Food selection involves personal individual experiences, thoughts, feelings, values, social, and cultural rules that interact with his physiological needs and desires (33, 34). The ability to select one's food contributes to the autonomy of the individual and reassures pleasures during the feeding process. It is noteworthy that individuals choose their food based on previous life experiences, spiritual beliefs and cultural patterns, and thus there are complex links among food, identity, and social participation. Modified textures in food can lead to damages in social and psychological aspects (31). Therefore, dysphagia may approach limitations when feeding habits are changed, resulting in significant negative impacts on psychosocial outcomes associated with eating and drinking (21). Patients report not enjoying pureed food, which is described as being inferior in terms of sensory appeal and lack of variety. Besides, pureed products are often indistinguishable from each other (35, 36). However, the goal of pureed food is to maintain safe consumption, prioritizing texture over both sensory appeal and acceptance (37). In addition to the limited food pleasure and decreased quality of life resulting from a modified diet in terms of appearance, texture, and taste, it is essential to address patients' lack of adhesion to treatments and recommendations suggested by speech-language pathologists (38-40). Health professionals are often confronted with the conflict between individual food preferences and necessary health benefits when selecting specific food characteristics as facilitators to the feeding process (21). These circumstances raise challenges to professionals who must consider the importance of the aspects of eating and drinking to maintain health and prolong life (21, 46). Therefore, speech therapists should be committed to achieving safe food consumption while respecting patients' preferences and considering appearance, taste, and variety of their diets to support food pleasure and quality of life indices.

1.2 Food characteristics and swallowing physiology

Food characteristics including taste, moisture, temperature, viscosity and texture, can be used as facilitators and intend to reduce swallowing disorders and favor the intake (17, 20). Swallowing mechanism is dependent upon bolus characteristics (18), swallowing volume, utensil used and supply rate (18, 25, 26, 29-31). Some attributes are considered generally beneficial for the swallowing process, such as cold temperature, sour taste (25, 29, 30), pasty viscosity, and homogeneous texture (7, 25), as we discuss below.

1.2.1 Taste

Swallowing function is highly influenced by chemosensory input, providing insight into how oral sensation regulates pharyngeal swallowing (41). Studies show a beneficial association between sour taste and swallowing physiology (30, 43). Tests with sour tastes demonstrated benefits on swallowing patterns such as the reduced risk of laryngotracheal penetration (30), positive influence on the pharyngeal transit time, increased perception of bolus, and afference through cranial nerves pairs (30, 41, 42). Sour taste can alert the individual's nervous system to the next swallowing, making it more efficient and safer (44). Effects may persist for at least 90 minutes after the presentation of sour taste (45). It also provides a lower risk of penetration-aspiration due to decreased oropharyngeal transit times (46). Evidence points to varying ability to detect taste according to age and a decline in flavor perception with increasing age (47), without specific data for sour taste. The relationship between sour stimulus, swallowing physiology and dysphagia brings special attention to the perception of this particular flavor.

1.2.2 Moisture

The moisture content is an indicator of food quality, and its reference value varies significantly amongst the food (48). The primary constituent in the moisture is water, followed by some small volatile compounds (48). Several analytical procedures are available to assay the moisture content in food product. The choice is based on the expected moisture content of a food. In dry food, the most common and recommended assay is the gravimetric (49). Concerning the swallowing process, moisture is associated with the passage of the bolus from the oral cavity to the stomach. If the bolus is moist and lubricated, this passage will be facilitated (50). A moist diet also favor the oral fluid intake, and the enjoyment of fluid dense foods. In contrast to thickened beverages, may be an interesting alternative to increase fluid intake of those with dysphagia (51). In this sense, contribute to reduced dehydration rates.

1.2.3 Temperature

Temperature is another attribute that can be used in modification diets for dysphagia management since cold stimuli are beneficial for swallowing patterns (29, 30, 41). Cold thermal sensation in the region of the pillar of the fauces intensifies the responses of the area, and when the food is presented, the individual triggers deglutition faster (52). The benefits of cold temperatures for the management of OD are intensified if associated with sour flavor (29).

1.2.4 Viscosity and texture

Thick and homogeneous diets are generally considered by speech therapists to promote safe and efficient swallowing, (7, 10, 25, 53-55) compensating deficits and decreasing aspiration risk (10, 11, 27, 54-58). Liquids are related to laryngeal penetration (26), and thickened beverages improve swallowing parameters in neurological patients (7, 8, 53-56). Meantime, an increase in viscosity promotes various modifications, such as turns oral and pharynx transit longer (7), raises chances of food residues in mouth and pharynx (7, 25, 54), and demand greater tongue pressure on the palate when swallowing (7, 59). Low viscosity leads to very rapid passage through the pharynx with the risk of penetration into the airway before protection mechanisms start, and high viscosity prolongs oral and pharynx transit and leads to stasis, increasing the possibility of aspiration (25). Patients who tend to aspirate thickened liquids have specific swallowing characteristics that are not the same as those who aspirate non-thickened liquids (53). In this way, the liquid must be thickened in the exact viscosity to improve the safety of swallowing for each patient, since very thin liquids can be as detrimental as the thickened excessively (27) and the correct selection depends on the evaluation findings (19).

1.3 Terminology standardization

In addition to the accurate selection of food characteristics, another aspect to be considered by professionals is the nomenclature used to designate different consistencies for dysphagia management. The prescriptions at clinical practice and scientific literature involving viscosity and texture should allow efficient communication between professionals, and the lack of terminology standardization impairs the rehabilitation process (8, 61, 62, 64, 65). The viscosity of thickened liquids is often judged subjectively and described using terms such as syrup and honey (63). The lack of standardization of consistency nomenclature generates risks to the patient (3, 20, 29), especially for those patients who are hospitalized. They receive treatment from different professionals, and the use of standardized nomenclature decreases the risks of misconducts. Several international companies use different terminologies and definitions (66-70). Some countries, including the United Kingdom, Japan, Ireland, New Zealand, Australia and Israel, use standardized terminology (8, 71). A similar standardization was introduced in the United States by the National Dysphagia Diet Task Force (NDD) (67). NDD was published in 2002 by the American Dietetic Association to establish standard terminology and practical applications of dietary texture modification in dysphagia and establishes four levels for liquid foods (72). These terminologies describe viscosity level and present some quantitative forms to identify food’s texture (8, 73). In 2016, the Dysphagia Diet International Standardization Initiative (IDDSI) established new terminology and procedures, aiming to improve the lives of 590 million people all over the world who live with dysphagia. It proposes to improve safety, reliability, and quality of food, reduce costs associated with waste and errors, and include diet chart with eight levels, from 0 to 7, for solid and liquid consistencies (8). According to this classification, 0 is thin, 1 slightly thick, 2 is mildly thick, 3 moderately thick or liquidized, 4 extremely thick or pureed, 5 minced and moist, 6 soft and bite-sized, and 7 is regular-easy to chew (74). The initiative also includes a specific document about home testing methods to identify the consistencies via syringe, fork, and spoon, facilitating the guidance of patients and caregivers (74, 75). Such standardization increases the efficiency of communication between staff members both within and between health institutions.

Figure 1: IDDSI terminology (74, 75)

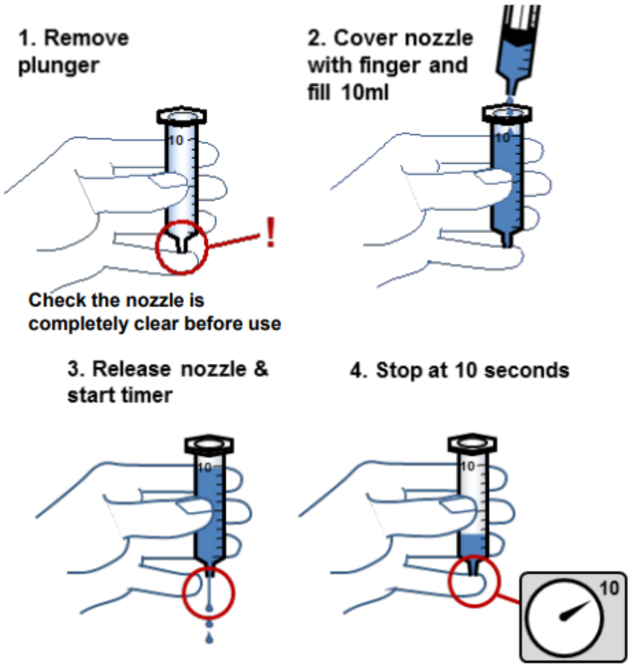

Figure 2: flow test (74, 75)

1.4 Use of commercial thickeners in the management of dysphagia

The management of consistency, involving modified foods and the thickened liquid became the cornerstone of the control of oropharyngeal dysphagia (8). Changes in diet consistency can be obtained from the use of blended foods (17). Still, such properties are little known by patients, caregivers, and professionals (76), and have the disadvantage of being greatly influenced by the manner of preparation and use of ingredients (25). When speech therapists need to change food viscosity in a patient diet (62) by appropriate increases in the thickness of liquids (10), commercial thickeners are usually prescribed and represent a useful tool in the management of dysphagia (59, 76-79). Several factors influence the use of these products and must be considered: ingredients that make up the thickener (28, 55, 77, 78, 80, 81), stability of the thickened material over time after preparation (20, 60, 77, 78, 82), type of liquid used (60, 78, 79, 83, 84), fluid temperature (28, 60) and adding medications (60). Manufacturer's instructions described in thickener labels do not include these variables, increasing the possibility of inadequate preparation and consume of the food with the inappropriate viscosity, which should interfere in the swallowing physiology, generating risks for patients (67-70, 74). Products containing cornstarch, in the raw or modified forms, will suffer salivary amylase effect, decreasing drastically the viscosity of thickened fluid even when gums are added (77, 79, 98). The pH of base fluid can interfere in the action of amylase on the thickened beverage (85). Different base liquids require different amounts of thickener to achieve the same viscosity (78, 86-92). Still, many manufacturers do not consider this interaction and recommend a single quantity of product regardless of the base liquid that will be thickened (85). Regarding temperature effects on the viscosity of samples, lower temperatures result in higher viscosity (28, 85, 86, 88, 91, 93, 94). As for the variable time, thickness increases if the waiting time after preparation is prolonged (85-88, 91). Sensory information related to thickened drinks must also be considered, once modifications in taste, smell, or appearance of fluids can reduce daily oral intake (87). The clinician and researcher must still be aware of the acceptability of the thickened beverage (7, 27, 78, 80, 95-98) that affects the amount of consumed liquid (7, 78, 96). Finally, when prescribing commercial thickeners, it is critical to consider nutrition issues involved (20), the high cost, and the difficulty of accessing the product (76).

1.5 Pectin

As discussed above, available commercial thickness to date have not been successfully used in the management of food consistencies. It is necessary to improve such products in order to bring more stability to the thickened beverages. Pectin as a natural product, can offer a relevant contribution given its gelling and stabilizing properties. the present work aims to develop a product for the management of dysphagia based on pectin extracted from the albedo of citrus fruit, *Citrus sinensis* and *Citrus lemon,* so it is useful to discuss the gelling and stabilizing properties of pectin.

Pectin, an acid polysaccharide component of plant cell walls (99), have been widely used as a functional ingredient in the food industry in a variety of ways, as texture modifier, stabilizer, thickener and gelling agent in different products (100, 101), but not specifically for dysphagia management. After more than 200 years since the discovery of pectins, their properties are still widely studied due to the lack of homogeneity of its physical and chemical structure (102). This fact is probably due to its broad complexity as a macromolecule, since its is composed of at least 17 different monosaccharides, bearing more than 20 different linkages (103), which is responsible for its most important property: gel formation (103). The most abundant residues in pectin are galacturonic acid (GalA), in which varying proportions of the acid groups are present as methoxyl esters, while a certain amount of neutral sugars (103).

Pectin is a versatile, abundant, multi-functional polymer (100, 105) whose versatility and ability contribute to new functionalities and the increased optimization of the extraction techniques (100) enables the comprehension of its gel behavior (106). Pectin is also the target of research involving additional beneficial properties such as reduction of total cholesterol and LDL (107), inhibitory action for the aggregation of cancerous cells and potentially limiting for metastases (108-111).

1.5.1 Pectin extraction

Pectin may be extracted from different fruits and their parts, such as passion fruit peel (112, 113), dragon fruit (114), guava husk (115), melon waste (116), apple pomace (117), tamarillo fruit (118), fig seeds (119), orange and mandarin albedo (120), mango (121), strawberry, blackberry and raspberry (106), melon (122), pear (123).). However, the primary sources of commercial pectin are apple pomace and citrus peel (124). Pectin is mostly extracted from the citrus peel (85.5%) (125), such as C*itrus lemon* (126; 127), *Citrus maxima* (128, 129), navel orange (130) and *Citrus ponkan* (104). When producing orange juice, many parts of orange is left unused and can be used to feed animals or as fertilizer (131). In recent years, there has been a more intense study of the use of agro-industrial wastes for the extraction of pectins with good technological properties as an alternative for use (121) providing higher financial yield and less waste (131).

The production of pectin on an industrial scale does not present rigorous control having a mix with other substances, and obtaining pectin of high rheological quality may favor the cost-benefit of the product (132). The extraction process is of high relevance in the production of pectin, with influence on the quality and yield of the final product (113, 133), depending on the manufacturer, the type of pectin desired and the botanical origin (121). Several methods may be employed; the most common are those using alcoholic solutions and citric acid.

Pectin yield and molecular characteristics (degree of esterification, galacturonic acid content, molar mass and rheological behavior) varies according to the source and environmental factors (134, 135). Considering conditions of extraction, pectin yield may be affected by different variables, such as temperature, time and pH conditions, increasing yield with the decrease of pH (104, 113, 130, 133). At lower extraction pH values, higher yield and viscosity are obtained, in the other hand, the galacturonic acid content decreases, indicating that the pectin has a mixture with other constituents (128). Extraction time is also critical to the characteristics of the pectin obtained (113, 133). Obtaining pectins with different characteristics and properties, researchers investigate and compare the most varied extraction methods, such as ammonium oxalate (pH 4.6, 85°C, 1 h), hydrochloric acid (pH 1.49, 85°C, 1 h) and deionized water (75°C, 1 h) for dragon fruit (114), different citric acid concentrations and extraction times for passion fruit (112), oxalic acid/ammonium oxalate (pH 4.6), sodium hydroxide and distilled water (75°C, 1 h) for melon (122), hydrochloric acid, citric or oxalic acid-ammonium oxalate under different conditions of pH and temperature for mango (121). Considering methods used to extract pectin from citrus, studies report the use of water extraction (orange and lemon, pH 2.2, 45 min) (136); water extraction (*C. maxima,* 80ºC, pH 4.5) yield 4.40% (128); water extraction, ammonium oxalate solution (*C. maxima,* pH 6.5, 10h) yield 8.89-10.87% (129); only distilled water (*C. lemon,* pH 7) yield 10.83% (126); microwave and soxhlet extraction of navel orange, yield 1.60-2.00% (130).

1.5.2 Pectin properties

Pectin gels are viscoelastic food systems and present rheological behavior that combines characteristics of solids and liquids (137). The pectin concentration required for gel formation depends on the type of pectin, characteristics influenced by extraction method and botanical origin (121). The gelling property of pectin is influenced by its degree of esterification (DE), being classified as high content of methoxyl when that value is above 50% and low methoxyl content when the DE is below this level (133). The degree of esterification is a characteristic of pectin that determines its ability to form stable gels (138). The rheological behavior and gelling properties are mostly related to the degree of methyl esterification (104, 118). Low-methoxylated (LM) and high-methoxylated (HM) pectins, which methoxylation degree is above 60%, have distinct gel formation mechanisms. Gel formation occurs when portions of homogalacturonan form a three-dimensional network where water and solutes are retained (118). High-methoxyl pectins demonstrate a greater ability to form gels (104, 118). LM pectin enable the formation of stable gels in the presence of metal ions and absence of sugar (115, 133). The gel is formed in the presence of divalent cations over a wide pH range, allowing them to be used in low sugar and low acid products. HM form gels in an acidic medium at low pH values (2.0 - 3.5) in the presence of sugar with reduced water activity. Occur junction and stabilization of the chain network by hydrophobic interactions between methyl groups and hydrogen bonds between the protonated carboxylates and hydroxyl groups (102). The interaction generates a high interconnection between the homogalacturonan chains, contributing to a rigid three-dimensional network that holds water. This property makes HM pectins use suitable for the development of gels and jellies (118). The use of high-methoxylated pectin as a stabilizer of viscosity in thickened beverages at different pHs presents positive results (139), indicating the possibility of use in products intended for the management of dysphagia.

While pectin is commonly extracted from citrus fruits, it is also possible to obtain modified citrus pectin (MCP), a dietary supplement produced by changing the extraction pH and temperature. MCP includes low molecular weight and esterification, facilitating their absorption, while the regular citrus pectin has varying sizes and high esterification (109, 111, 124). However, MCP has the lower gelling ability when compared to non-modified citrus pectin (124), once presents a lesser degree of esterification, which influences the rheological properties of pectin, reducing its viscosity (134).

1.6 Hypothesis and specific aims

Hypothesis 1 and goals 1, 2 and 3:

The speech therapists have little concern with quality of life for dysphagic patients in relation to preferences, choices and food pleasure and have a poor understanding of the characteristics of food and its influence on the physiology of swallowing. However, they know about the use of the standardization of viscosity nomenclature; otherwise, their practice may generate risks to the patients.

Therefore, the main goal of **chapter 2** is to disclose indications of foods that are considered ideal by speech therapists for aiding patients with dysphagia to better understand their feeding quality concerns and ultimately alleviate the difficulties of the disorder (chapter 2).

Thus, the primary purpose of **chapter 3** to investigate the knowledge of speech therapists about aspects of food used in the management of dysphagia, considering the variables texture, viscosity, temperature, taste and moisture influence swallowing patterns and that speech therapist is the professional responsible for evaluate and modify such aspects in order to facilitate the intake (chapter 3).

The **chapter 4** of the present study aims to verify the ability of speech therapists to identify, sort, and nominate different consistencies used in NOD management and to compare the results with the terms proposed by the Dysphagia Diet Standardization Initiative (IDDSI) (chapter 4).

Hypothesis 2 and main goals 4 and 5:

Considering the requirement of thick liquids during dysphagia treatment, the influences that may occur in the preparation of thickened beverages and the need for detailed information on product labels, the commercial thickeners lack the stability to provide safe management of dysphagia and therefore, the need to change consistency in the diet of dysphagic patients, the limitations presented by the commercial thickeners commercialized in Brazil, and the gelling characteristics of pectins, it is supposed that pectin can be used as a thickener and stabilizer in a product intended for the management of dysphagia.

The objective of the study disclosed in **chapter 5** is to analyze seven commercial thickeners in terms of composition, employed terminology, preparation instructions, nutrition values and viscosity (chapter 5).

The objective of the study disclosed in **chapter 6** is to develop a food thickener for the management of dysphagia from the pectin extracted from the albedo of citrus fruits: *Citrus sinensis* and *Citrus lemon* (chapter 6).

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CHAPTER 2

DYSPHAGIA, FOOD PLEASURE AND QUALITY OF LIFE: DO WE CARE ABOUT IT?

CHAPTER 2

DYSPHAGIA, FOOD PLEASURE AND QUALITY OF LIFE: DO WE CARE ABOUT IT?[1]

Authors: Alessandra Salles Machado; Karla Lima Vargens; Tathyany Ferreira Armini; Tiago Costa Pereira; Dominik Lenz, Denise Coutinho Endringer

ABSTRACT

Purpose: To discover indications of foods that are considered ideal by speech therapists for aiding patients with dysphagia to better understand their feeding quality concerns and ultimately alleviate the difficulties of the disorder. **Methodology:** This study was approved by the Research Humans Ethics Committee (56273316.0.000.5064). Data were collected using a questionnaire developed by the researchers, which was further uploaded in the SurveyMonkey® program (www.surveymonkey.com). The questionnaire addressed food indications considered ideal for safely feeding patients with dysphagia. Answers were analyzed by IRaMuTeQ software version 0.7 alpha 2, a statistical textual software. Evaluated texts portrayed strict relations to food characteristics, such as texture and viscosity. Moreover, proposed specific courses were included in the analysis. **Findings:** Strong representation of the words “Puree” and "Potato" was found and connected to similar terms such as “Yogurt,” “Pasty,” “Soup,” and “Porridge,” which were also highlighted. Most of the participants indicated pasty and homogeneous options without considering issues such as preference, variety, and appearance, which are all strongly linked to the socio-cultural contribution of food. **Research limitations:** The main limitation of this research was the fact that the sample was composed of speech therapists from different specialties. Some of them informed to work with another specialty. **Practical implication:** This study provided insight into speech therapy practices for dysphagia treatment and the relation among food preferences, quality of life and a modified diet. **Originality:** Speech therapists should be committed to achieving safe food consumption while respecting patients’ preferences and considering to support food pleasure.

Keywords: Food; Diet; Deglutition Disorders; Texture Modification; Dysphagia

Introduction

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The process of choosing food is not an easy task. By selecting a food, a person uses individual experiences, thoughts, feelings, values, social, and cultural rules that interact with his physiological needs and desires (Devine, 2005). Food is essential for survival, and related pleasure arising from its consumption represents great satisfaction in daily life (Kringelbach, 2015). Food intake and its associated pleasure can be affected by certain medical conditions such as oropharyngeal dysphagia (OD) (Abdulmassih, Teive, and Santos, 2014), a feeding disorder with a neurological or structural basis (Logemann, 2007). As a potential source of pleasure and general well-being, the food eating process includes phases related to expectation, consumption and satiety (Kringelbach, Stein and van Hartevelt, 2012). Responses to a meal, including the sensory experiences, include some sequences of events, not only before and during food ingestion but also after meal completion in post-prandial period (Pribic *et al.*, 2018). However, these aspects may be affected in patients with OD.

The ability to select one's food contributes to autonomy of the individual and reassures pleasures during the feeding process. It is noteworthy that individuals select their own food based on previous life experiences, spiritual beliefs, and cultural patterns, and thus, there are complex links among food, identity, and social participation. Under normal conditions, feeding is associated with a pleasant sensory experience, involving sensations related to homeostasis, satiety, fullness, with a hedonic dimension.(Pribic and Azpiroz, 2018; Monrroy *et al.*, 2019) Therefore, dysphagia may approach limitations when modifying these feeding habits and result in significant negative impacts on psychosocial outcomes associated with eating and drinking (Kenny, 2015).

In order to guarantee safe and efficient deglutition, speech therapists promote changes in daily diets by modifying texture, consistency, taste, and temperature of foods (Silva, Luchesi, and Furkim, 2017; Flynn *et al.*, 2018). However, modified textures in food can lead to damages in social and psychological aspects (Flynn *et al.*, 2018). Health professionals are often confronted with the conflict between individual food preferences and necessary health benefits when selecting specific food characteristics as facilitators to the feeding process (Kenny, 2015).

OD patients can have impacted quality of life (Chen *et al.*, 2009; Brandão, Nascimento and Vianna, 2010; Kenny, 2015) due to the use of modified foods (Silva, Luchesi and Furkim, 2017; Flynn *et al.*, 2018), which may intensify the risk of choking, suffocation, aspiration, pulmonary alterations and weight loss (Kenny, 2015). Tests comparing quality of life indices in individuals with and without dysphagia indicated more satisfactory in general health and vitality for individuals presenting intact eating process (Brandão, Nascimento and Vianna, 2010). Therefore, modification of foods and fluids can be correlated to a decreased quality of life (Swan *et al.*, 2015).

Consumers reported an unwillingness to eat pureed food, which had been described as having a lack of variety, being often indistinguishable from each other, thus developing a “poor” sensory appeal. (Keller and Duizer, 2014). However, the goal of pureed food is to maintain safe consumption, prioritizing texture over both sensory appeal and acceptance (Ettinger, Keller and Duizer, 2014).

In addition to the limited food pleasure and decreased quality of life resulting from a modified diet in terms of appearance, texture and taste, it is important to address patients’ lack of adhesion to treatments and recommendations suggested by speech-language pathologists (Colodny, 2005; Kaizer, Spiridigliozzi and Hunt, 2012; Shim, Oh and Han, 2013).

These circumstances raise challenges to professionals who must consider the importance in the characteristics of eating and drinking to maintain health and prolonged life (Kaizer, Spiridigliozzi and Hunt, 2012; Kenny, 2015). Therefore, speech therapists should be committed to achieve safe food consumption while respecting patients’ preferences and considering mainly appearance, taste, and variety of their diets to support food pleasure and quality of life indices.

The present research aims to discover indications of foods that are considered ideal by speech therapists for aiding patients with dysphagia to better understand their feeding quality concerns and ultimately alleviate the difficulties of the disorder.

Methods

This study was approved by the Human Ethics Committee (56273316.0.000.5064 - (Appendix A). Data were collected using a questionnaire developed by the researchers made available in the SurveyMonkey® program (www.surveymonkey.com). SurveyMonkey® is a cloud-based ("software as a service") online research development company, and it was chosen because it offers a practical tool for conducting quantitative and qualitative research. The questionnaire addressed food indications considered ideal for safely feeding patients with dysphagia. The participants encompassed speech pathologists who work with speech, voice, language and deglutition disorders and who were encouraged to provide answers based on their knowledge and professional experience in treating patients with dysphagia.

A message explaining the research goals with the questionnaire link attached was posted by e-mail and on different social media platforms (Facebook®, WhatsApp® and Instagram®), inviting professionals to participate in the study. At the beginning of the questionnaire, informational text corresponding to the Informed Consent Term (ICT) was presented and participants digitally signed their consent to both prove their honesty as a speech therapist and to agree to respond to the questions. The questionnaire was initiated by 1072 speech therapists, but 320 (33.5%) did not complete it, leaving 752 (70.1%) participants.

The participants were to provide descriptions on the characteristics of food they would offer patients presumably diagnosed with OD. All food descriptions were collected in a data base on Word version 2016. The data were then analyzed by IRaMuTeQ® version 0.7 alpha 2, a statistical textual software. This software has been described in literature (Santos *et al.*, 2017) as one of the most reputable tools for textual analyses. Therefore, the analyses were based on textual structure and speech organization followed by creating statistical relations to lexical fields that were most frequent enunciated by the participants. IRaMuTeQ® uses the R Statistical Software to establish said calculations.

For statistical purposes, multivariate analysis (descending hierarchical classification, analysis) and Similitude analysis were proposed. Descending Hierarchical Classification Method (DHC) - Text segments are classified by their vocabulary, and their set is divided by the frequency of the reduced forms. From matrices crossing text and word segments (in repeated x^2 tests), the DHC method is applied and a stable and definitive classification is obtained (Reinert, 1987). This analysis aims to obtain text segment classes that, at the same time, present similar vocabulary to each other, and different vocabulary from the text segments of the other classes. From these matrixes analyzes, the software organizes the data analysis into a DHC dendogram, which illustrates the relationships between the classes. The program performs calculations and provides results that allow to describe each of the classes, mainly by their characteristic vocabulary (lexicon) and their asterisk words (variables).

Similitude analysis is proposed because it is based on graph theory (Marchand and Ratinaud, 2012) and it is often used by researchers of social representations (social cognition). This analysis makes it possible to identify the co-occurrences between the words and its result brings indications of the connectedness between the words, helping to identify the structure of the representation.

The assessed texts showed strict relations to food characteristics, such as texture and viscosity; additionally, proposed specific courses were included in the analyses.

Results and discussion

IRaMuTeQ presented a textual corpus composed of 749 texts, separated in 750 text segments (TS), wherein 491 (65.47%) were used for analyses. Out of 2,415 occurrences (words, forms of words), 344 were distinct words and 180 had a single occurrence. The content analyzed was categorized into four classes: Class 1, with 159 TS (32.38%); Class 2, with 136 TS (27.7%); Class 3, with 87 TS (17.72%); and class 4, with 109 TS (22.2%).

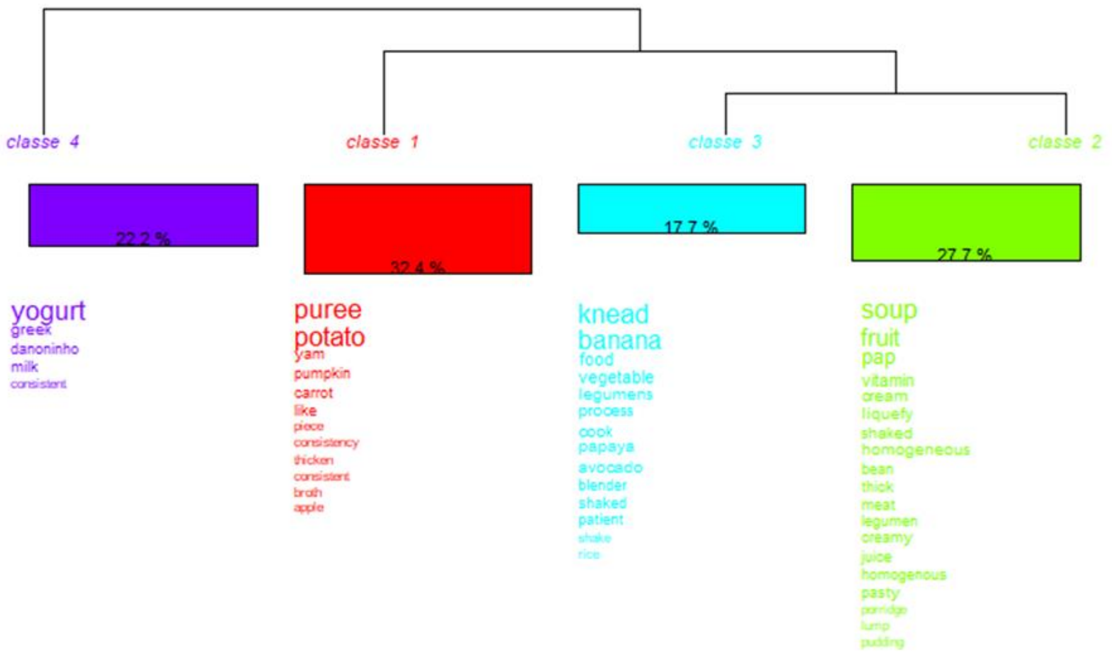

Figure 1 - Hierarchical Classification descending from the textual Corpus

It is noteworthy that these four classes are divided into two branches (A and B). Subcorpus A, or "Food and Characteristic," is composed of Class 1 ("Food texture"), referring to the food texture recommended by the respondents. Classes 2 and 3 are both derived from Class 1. As their names suggest, Class 2 “Food” represents the group where the respondents suggested the type of food and Class 3 “Food prepared” suggests examples of how the food should be prepared safely. Subcorpus B, titled "Viscosity", contains the names of foods and aspects related to their preparation occurring within Class 2 ("Food") and Class 3 ("Food prepared"), thus contemplating the consistency desired by the respondents when either preparing food or guiding family members or caregivers to prepare it for patients.

The words “Potato” and “Puree” are highlighted, signifying that several participants consider proposing this food type and texture to their patients. This standardization may indicate that professionals are not concerned with the variety nor appearance of the preferred foods. This is an alarming fact because it contradicts a biopsychosocial aspect in alimentary process. People choose their food based on their way of living. Some researchers have concluded the multifactoriality of motivations for eating and choosing the food. They also concluded that even in different socioeconomic contexts, other determinants of food choice, not necessarily related to socioeconomic status, may be relevant in why people eat what they eat (Moraes, 2018). Food Guide for the Brazilian Population defines food as “more than nutrient intake”. It is characterized as an act that “concerns the intake of nutrients, but also the foods that contain and supply the nutrients, how foods are combined and prepared, the characteristics of eating and the cultural and social dimensions of the practices” (Brasil, 2014; Rotenberg and De Vargas, 2004).

Moreover, in terms of feeding pleasure, identical foods in daily diets may not ensure the preparatory phase or even instigate patients to feed. Pureed foods are often described as poor in terms of sensory appeal and variety for often being indistinguishable from each other (Keller and Duizer, 2014), which can lead to a non-adherence to treatments and speech therapist guidelines.

Additionally, inferential analyses are confirmed when Classes 2 and 3 are related to Class 4 in which certain foods with pasty consistency are described. It is worth mentioning that visual aspects were not considered when associated to therapeutic aims.

The Similitude Analysis qualitatively observed the participants’ responses to verify the most recurrent evocations including words that were more related to specific terms.

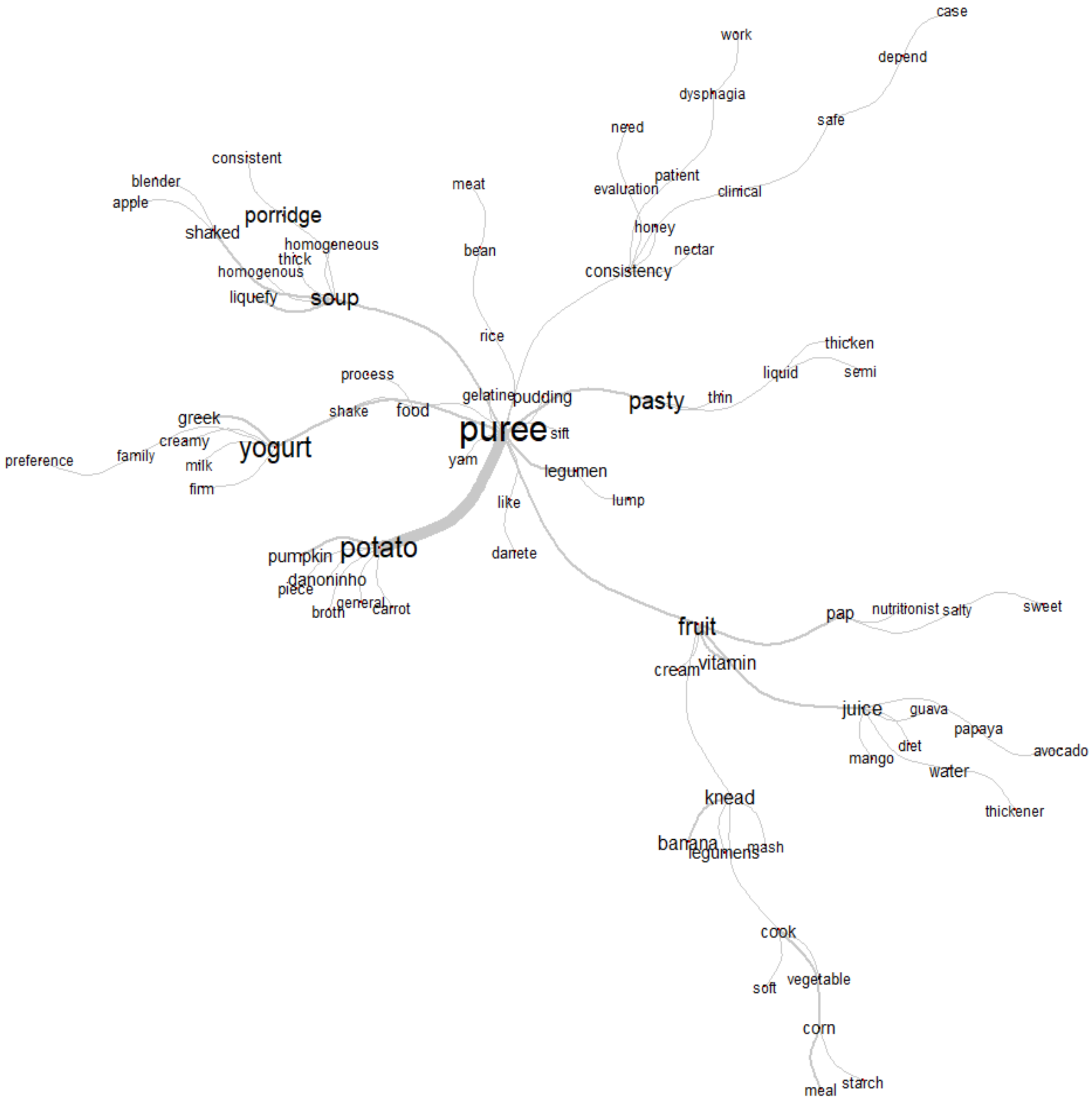

Figure 2 - Similitude Analysis: relation among words

The analysis also displays the significant representation of the words “Puree” and "Potato". Since “Puree” and “Potato” were considered the foundation, they were evidently connected to other highlighted words, such as “Yogurt”, "Pasty", "Soup" and “Porridge”.

Intending to ensure this information, a word cloud was created from the entire textual corpus.

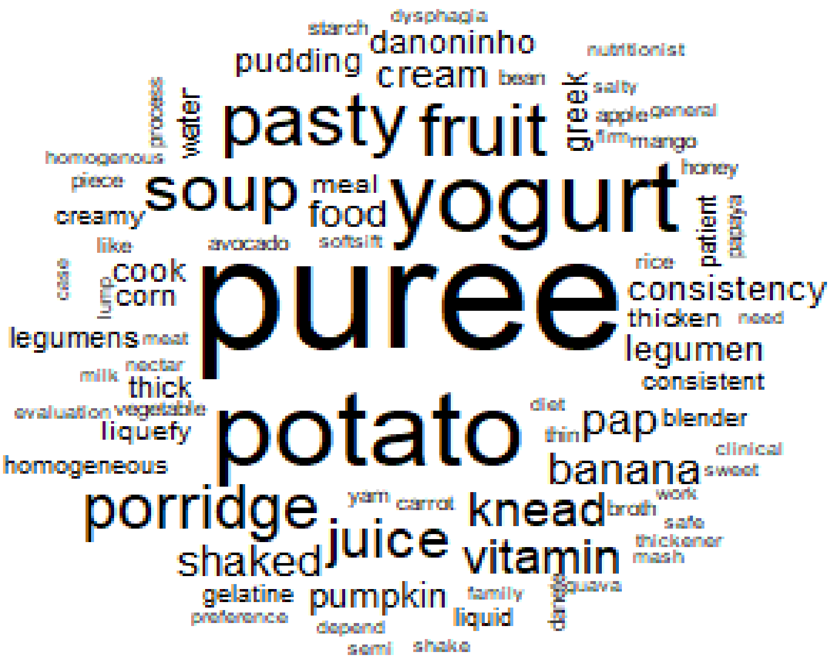

Figure 3 - Word cloud of textual corpus.

In conclusion, it is evident that food preferences and pleasure during feeding processes are not considered by professionals by suggesting foods words such as “Yogurt,” “Kneed,” “Banana,” “Soup” and “Pap,” which are culturally associated to children and the elderly, thus these terms may present unfavorable limitations for OD patients and their families.

Suggested foods in their responses are also not conducive to strengthening social and cultural aspects associated with feeding.

Patients with OD currently present altered cognition state. Some researchers pointed out that hedonic/affective responses to food have a critical role in eating behavior (Sato *et al.*, 2016). Another study demonstrated that homeostatic states modulate unconscious hedonic responses to food and that this phenomenon is related to daily eating behaviors (Killgore *et al.*, 2003). These findings reassure to speech therapists the need to select food based on what the patient had pleasure in feeding.

Although the majority of the respondents did not mention any consideration about feeding pleasures for patients’ intake, certain participants considered at least some of their preferences. Subject 206 answered: *“I suggest Danoninho, Legumens. According to the* ***preference*** *and acceptance of the patient.”* Subject 327 stated: *“I usually ask family members* *about the patient's food* ***preference*** *and recommend to the family to display it in the form of soup."* Subject 388 answered: *"Fresh Juice according to the patient's* ***preference****"*. According to English Oxford Dictionary, *preference* is "a greater interest in or desire for somebody/something than somebody/something else (*'Citation'. Oxford Advanced Learner's Dictionary*, 1990). This psychosocial approach contributes to healthy eating, turning it into a positive, safe, peaceful and comfortable act. It is to understand that the motivations and choices of individuals are not based solely on the nutritional and energetic contribution of food and that it is therefore counterproductive to define and propagate a reductionist definition of adequate food that does not contextualize and understand the complex individual-biology-culture-environment-food (Kringelbach, 2015). Therefore, the previous respondents successfully expressed their care towards their patients' preferences. However, analytically, this proves that only 3 respondents (0.4%) considered patient preferences while recommending food preparation. On the other hand, several participants indicated pasty and homogeneous options following a clinical approach to rehabilitate and establish safe oral feeding. Nevertheless, merely restricted varieties were recommended without considering issues significantly linked to food such as preference, variety, appearance and sociocultural contribution. Some researchers have stated that eating just like any other behavior, involves motivation. An individual may be motivated to eat, for example, due to physiological factors such as hunger and satiety; for the pleasure of eating; by external eating stimuli, such as for the emotional, social and cultural reasons as well as for the smell and appearance of food (Bellisle, 2009; Renner *et al.*, 2012).

In some cases, patients with OD may experience chemosensory impairment due to neurological damage or because the aging process. Some researchers evaluated the impact of chemosensory impairment on diminished eating pleasure and appetite in independently older adults (Arganini and Sinesio, 2015). Their sample comprised 239 individuals and their findings showed that chemosensory impairment may not be related with diminished eating pleasure and appetite, while other non-physiological factors such as loneliness, dietary restrictions and subjective health should be taken more into account in order to develop effective strategies to counteract malnutrition (Arganini and Sinesio, 2015).

Considering the methods applied in this research, it is plausible to affirm that they were effective in pointing out the speech content of the participants. The IRaMuTeQ® software was specific in the treatment of data and providing the Similitude analyzes and descending hierarchical classification. The relation between the words used by the participants and the lack of variety of food simply reassures the need to promote more research about the food pleasure. However, it is important to highlight that, although eating pleasure is not considered in the treatment of OD, all participants expressed concern about the maintenance of health and food safety. It is important to understand these results with a warning of what is not being evaluated by our protocols and therapeutic plans.

This study provided an insight to speech therapy practices for dysphagia treatment and the relation among food preferences, quality of life and modified diet. Thus, this research highlighted the complexity involved in dysphagia rehabilitation and its impacts in daily life quality, emphasizing the importance of considering individual choices when regarding food as part of intervention programs. In this context, speech therapists will be challenged to equilibrate the risks and benefits of patients' preferred foods. Concisely, quality of life, feeding pleasure and adherence to the treatment must be the center of discussions between professionals and patients, including family or caregivers.

The main limitation of this research was the fact that the sample was composed by speech therapists from different specialties. Some of them informed to work with OD and another specialty. This fact suggests the possibility of some lack of further knowledge. However, this does not forbid the professional to work. Another limitation was the few spaces for the participant to answer. Although the methodology proved to be effective these participants could provide more information about the food and especially how they prepare and offer to their patients. In addition, further research should be carried out in order to clarify the real impacts of the lack of consideration about food pleasure for patients diagnosed with OD.

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All authors contributed significantly to both writing and analyzing this manuscript data.

Transparency Declaration:

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

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CHAPTER 3

FOOD CHARACTERISTICS AND OROPHARYNGEAL DYSPHAGIA: WHAT SPEECH THERAPISTS SAY

CHAPTER 3

FOOD CHARACTERISTICS AND OROPHARYNGEAL DYSPHAGIA: WHAT SPEECH THERAPISTS SAY[2]

FOOD CHARACTERISTICS AND DYSPHAGIA ANALYSES

Authors: Alessandra Salles Machado[1]; Karla Lima Vargens[2]; Tathyany Ferreira Armini[3]; Tiago Costa Pereira[4]; Dominik Lenz[5], Denise Coutinho Endringer[6]

1. Speech therapist, Professor at Universidade Vila Velha, Brazil 2. Speech therapist at Vila Velha, Brazil 3. Speech therapist at Vila Velha, Brazil 4. Speech therapist, Professor at Universidade Vila Velha, Brazil 5. Veterinary, Professor at Universidade Vila Velha, Brazil 6. Pharmacist, Professor at Universidade Vila Velha, Brazil

Abstract

Food intake is one of the greatest human pleasures and may be interrupted in oropharyngeal dysphagia, when the progression of food through the digestive tract is affected. Swallowing function is highly influenced by chemosensory input, providing insight into how oral sensation regulates swallowing. This study aims to investigate the knowledge of speech therapists about characteristics of food used in the management of dysphagia. This was a quantitative descriptive study, performed using an online questionnaire (SurveyMonkey®) about the desirable food attributes to facilitate the intake for dysphagia patients: variables texture, viscosity, temperature, taste and moisture. Participants were separated into two groups, experts in dysphagia and no experts in dysphagia. Differences between the two groups were compared using the Freeman-Halton extension of the Fisher exact probability test and chi-square test. From a total of 1072 respondents, 752 were included and 572 participants answered they were active working in dysphagia area. The speech therapist

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expert in dysphagia answered correctly about the texture and viscosity, while no experts answered correctly only about viscosity. The other attributes, temperature, taste and moisture, were incorrectly answered by both groups. The speech therapists participants demonstrated reduced knowledge regarding the characteristics of foods most indicated for patients with dysphagia.

Keywords: Deglutition; Dysphagia; Evaluation; Food and Beverages; Rehabilitation; Thickeners.

Introduction

Food intake is one of the greatest human pleasures and it may be interrupted in oropharyngeal dysphagia (OD), when the normal progression of food through the digestive tract is affected (Abdulmassih, Teive, & Santos, 2014). Quality of life can be decreased in patients with OD by the risk of choking, suffocation, aspiration, pulmonary alterations, nutritional deficiencies, weight loss and dehydration (Marques, Medrado, Martins, Lima, & Correa, 2017). Speech therapy improve swallowing patterns (Logemann, 2007) in order to guarantee functional oral diet and increase quality of life by establishing safe, efficient and pleasurable oral intake.

According to the swallowing pathophysiology, the rehabilitation program is established and promote changes in diet offered (Bridget, 2014; Garcia, Chambers, & Molander, 2005; Logemann, 2007). Texture, consistency, taste and temperature of foods, swallowing volume, utensil used and supply rate are modified when necessary (Cola et al., 2010; Silva, Luchesi, & Furkim, 2017), once swallowing mechanism is dependent upon bolus characteristics (Logemann, 2007).

Thick and homogeneous diets are considered to promote safe and efficient swallowing (Choi, Ryu, Kim, Kang, & Yoo, 2011; Hind et al., 2012; Leonard, White, Mckenzie, & Belafsky, 2014; Newman, Vilardell, & Speyer, 2016; Silva et al., 2017) compensating deficits and reducing aspiration risk (Hind et al., 2012; Leonard et al., 2014). However, literature describes various modifications related to the increase in viscosity: longer oral and pharynx transit (Newman et al., 2016; Silva et al., 2017), food residues retained in mouth and pharynx (Hind et al., 2012; Newman et al., 2016; Silva et al., 2017), need of greater tongue pressure on the palate when swallowing (Newman et al., 2016; Steele, Molfenter, Péladeau-Pigeon, Polacco, & Yee, 2014).

Temperature is another attribute that can be used in modification diets for dysphagia management, since cold stimuli are beneficial for swallowing patterns (Chee, Arshad, Singh, Mistry, & Hamdy, 2005; Cola, Gatto, Schelp, & Henry, 2008; Cola et al., 2010; Hamdy et al., 2003; Lazzara, Lazarus, & Logemann, 1986; Pelletier & Lawless, 2003; Silva et al., 2017). Cold thermal sensation in the region of the pillar of the fauces intensifies the responses of the area and when the food is presented the individual triggers deglutition faster (Lazzara et al., 1986). Benefits of cold temperature for the management of OD are intensified if associated with citric flavor (Cola et al., 2010; Hamdy et al., 2003).

Swallowing function is highly influenced by chemosensory input, providing insight into how oral sensation regulates pharyngeal swallowing (Chee et al., 2005). Tests with sour tastes demonstrated benefits on swallowing patterns such as reduced risk of laryngotracheal penetration (Pelletier & Lawless, 2003), positive influence on the pharyngeal transit time, increased perception of bolus and afference through pairs of cranial nerves (Chee et al., 2005; Kajii et al., 2002; Pelletier & Lawless, 2003).

Moisture is a characteristic that is associated with the passage of the bolus from oral cavity to stomach and if the bolus is moist and lubricated this passage will be facilitated (Cichero, 2016). A moist diet contributes also with the oral fluid intake and the enjoyment of fluid dense foods, in contrast to thickened beverages, may be an interesting alternative to increase fluid intakes of those with dysphagia (Vivanti, Campbell, Suter, Hannan-Jones, & Hulcombe, 2009).

Considering that variables texture, viscosity, temperature, taste and moisture influence swallowing patterns and that speech therapist is the professional responsible for evaluate and modify such aspects in order to facilitate the intake, this study aims to investigate the knowledge of speech therapists about characteristics of food used in the management of dysphagia.

Methodology

This was a quantitative descriptive study approved by the Research Ethics Committee (56273316.0.000.5064 - Annex A). Data were collected using a questionnaire prepared by the researchers and made available in the SurveyMonkey® program (www.surveymonkey.com).

The survey questionnaire

The questionnaire addressed the selection of food characteristics texture, viscosity, temperature, taste and moisture.

The questions related to five food characteristics: texture, viscosity, temperature, taste and moisture. Regarding the texture, the answers gave the terms “homogeneous”, “heterogeneous” and "texture does not interfere". As to viscosity, the alternatives were “pasty”, “liquid”, and “viscosity does not interfere”. For the temperature variable the alternatives were “cold”, “room temperature”, “warm” and “temperature does not interfere”. When questioning about the flavor the alternatives were “sweet”, “sour” and “taste does not interfere” and for the last variable, moisture, the responses would be “dry”, “moist” and “moisture does not interfere”. For each category, the expected correct answers were homogeneous texture, pasty viscosity, cold temperature, sour taste and moist.

Recruitment

The target population was all registered Brazilian speech therapist. A message explaining the research and containing the questionnaire link was sent by e-mail and social networks (Facebook, WhatsApp and Instagram) as an invitation to participate. At the beginning of the questionnaire, informational text corresponding to the Informed Consent Term (ICT) was presented, and the participants gave their consent to participate there (Appendix A).

The inclusion criteria were being a Brazilian speech therapist who agreed to respond to the electronic questionnaire and answered the questions about the 5 (five) food characteristics. The questionnaire "Food Characteristics and Oropharyngeal Dysphagia: What Speech Therapists Say" was answered by 1072 speech therapists, but 320 (33.50%) did not complete the questionnaire, leaving 752 (66.50%) participants.

Analyses Database

The collected data were arranged in tables, reviewed, and analyzed through the Survey Monkey program. The statistical analysis was performed using excel and http://vassarstats.net/index.html. Measures of central tendency (mean and median) and dispersion (standard deviation and minimum – maximum) were reported for each of the numeric variables of interest. The data were normalized in percentage into the group. Differences between the two groups were compared using the Freeman-Halton extension of the Fisher exact probability test and chi-square test. The significance level was $p < 0.05$. The statistical analysis was performed using excel and http://vassarstats.net/index.html.

Results

The questionnaire response rate was 70.2% (752 speech therapist) of total of 1072 respondents, being the main criteria of exclusion the questionnaires with missing answers.

Of the 752 respondent, 572 participants answered they were active working in the dysphagia area (G1) and 180 stated they did not work with dysphagia nor had previously worked (G2). Table 1 depicts the results of the five food characteristics: texture, viscosity, temperature, taste and moisture. The speech therapist expert in dysphagia answered correctly about the texture ($p < 0.05$). Both groups answered correctly that the food should be pasty ($p > 0.05$). The temperature of the food was not a consensus amongst the answers and both groups pointed the incorrect answer ($p > 0.05$). Although there is a difference between the dysphagia expert and no expert ($p < 0.05$) concerning the taste, the majority in both groups answered incorrectly. There was no difference in the groups regarding the moisture characteristic ($p > 0.05$) and both groups answered incorrectly.

Table 1. The questions related to five food characteristics: texture, viscosity, temperature, taste and moisture.

Characteristics	Participants			
	G1 (n=572)	**G2** (n=180)	**Total** (n=752)	**p**
Texture				
Heterogeneous	2 (0.34%)	3 (1.66)	5 (0.66%)	0.0098
Homogeneous*	392 (68.53%)	91 (50.55%)	483 (64.22%)	
Does not interfere	178 (31.13%)	86 (47.79%)	264 (35.12%)	
Viscosity				
Pasty*	357 (64.41%)	111 (61.66%)	468 (62.23%)	0.4971
Liquid	8 (1.39%)	8 (4.44%)	16 (2.12%)	
Does not interfere	207 (34.20%)	61 (33.90%)	268 (35.65%)	
Temperature				

Cold*	167 (29.19%)	23 (12.77%)	190 (25.25%)	0.6070
Warm	133 (23.25%)	27 (15.00%)	160 (21.27%)	
Room temperature	208 (36.35%)	100 (55.55%)	308 (40.95%)	
Does not interfere	64 (11.20%)	30 (16.68%)	94 (12.53%)	
Taste				
Sour*	67 (11.71%)	4 (2.22%)	71 (9.44%)	0.0213
Sweet	30 (5.22%)	11 (6.11%)	41 (5.45%)	
Does not interfere	475 (83.07%)	165 (91.67%)	640 (85.11%)	
Moisture				
Moist*	179 (31.29%)	52 (28.88%)	231 (30.71%)	0.8774
Dry	1 (0.17%)	0 (0.00%)	1 (0.13%)	
Does not interfere	392 (68.54%)	128 (71.11%)	520 (69.16%)	

G1: speech therapist experts in dysphagia. G2: speech therapist no expert in dysphagia.
*The expected answer for each characteristic.

Discussion

The homogeneous characteristic is indicated to facilitate food intake (Choi et al., 2011; Hind et al., 2012; Leonard et al., 2014; Newman et al., 2016; Silva et al., 2017), so the answer was assertive by the experts ($p>0.05$). However, it is worth mentioning the high number of participants who considered the response “texture does not interfere”, with values reaching 31.13% in G1 and 47.79% in G2.

For the characteristic viscosity, there was a predominance of pasty selection among all participants, with values above 60%. Pasty consistency is considered to be a facilitator for patients with dysphagia, promotes safe swallowing (Choi et al., 2011; Hind et al., 2012; Leonard et al., 2014; Newman et al., 2016; Silva et al., 2017) and reduces aspiration risks (Hind et al., 2012; Leonard et al., 2014). In this way, it can be considered that these responses were adequate. In the meantime, as for the texture variable, it is important to highlight the high number of responses "viscosity does not interfere", being 34.20% in G1 and 33.90% in G2. It is interesting to observe the similarity between these indices, since the practice with dysphagic patients did not guarantee more assertive answers.

The responses involving temperature demonstrated less standardization between the two groups than in the previous categories. The most notable response was “room temperature”, for both G1 (36.35%) and G2 (55.55%). The literature confirms the benefits of cold stimuli for swallowing dynamics (Chee et al., 2005; Cola et al., 2008, 2010; Hamdy et al., 2003; Lazzara et al., 1986; Pelletier & Lawless, 2003; Silva et al., 2017), but this alternative obtained the second best result in G1 (29.19%) and the worst result in G2 (12.77%). For the results of temperature variable, it was possible to observe a better result for G1 when compared to G2, but still presenting a high error rate (70.81%) when the inadequate responses (“warm”, “room temperature” and “temperature does not interfere”) are added. The low index “cold” responses could indicate the lack of knowledge of the professionals regarding the advantages offered by the use in clinical practice and in the prescription of cold food for patients with dysphagia.

As for temperature, the taste characteristic did not obtain assertive results in this research. The literature confirms the benefits of the sour taste for the swallowing process (Chee et al., 2005; Kajii et al., 2002; Pelletier & Lawless, 2003) such as reduced risk of laryngotracheal penetration (Pelletier & Lawless, 2003), positive influence on the pharyngeal transit time and increased perception of the bolus, but the alternative “sour” obtained extremely low responses, being 11.71% for G1 and 2.22% for G2. The great majority of participants opted for the answer “taste does not interfere”, demonstrating that they do not know the influence of taste on the dynamics of swallowing. The results indicate that the professionals who work with dysphagia are not using this characteristic in their clinical practice or in the prescription of food.

The last analyzed characteristic, moisture, presented similar results between the 2 groups, both of which selected the answer “moisture does not interfere” in its majority, G1 68.54% and G2 71.11%. According to the researched literature, moist foods are beneficial for oral and pharyngeal transit and contribute with the oral fluid intake (Cichero, 2016; Vivanti et al., 2009). Only 31.29% of G1 and 28.88% of G2 indicated moist trait.

Since swallowing mechanism is dependent upon bolus characteristics (Logemann, 2007), knowledge about the influence of texture, viscosity, temperature, taste and moisture is of extreme relevance for the speech therapist to plan a successful rehabilitation process. The results found in the present research indicated a restricted knowledge on such aspects, mainly in terms of temperature, taste and moisture.

Conclusion

The speech therapists participants of the research demonstrated reduced knowledge regarding the characteristics of foods most indicated for patients with dysphagia, presenting better results in the variables texture and consistency than in the variables temperature, taste and moisture. It is not possible to say that speech therapists working with dysphagic patients have more accurate knowledge about the influence of eating characteristics on the swallowing process than those who do not work with patients with dysphagia.

Ethical Statements

Conflict of Interest: The authors declare that they do not have any conflict of interest.

Ethical Review: This study was approved by the Research Ethics Committee 56273316.0.000.5064

Informed Consent: Written informed consent was obtained from all study participants.

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CHAPTER 4

CONSISTENCIES AND TERMINOLOGIES - THE USE OF IDDSI

CHAPTER 4

CONSISTENCIES AND TERMINOLOGIES - THE USE OF IDDSI[3]

ABSTRACT

Introduction: This study aimed to verify the ability of speech therapists to identify, sor[3]t and name different consistencies used in neurogenic oropharyngeal dysphagia (NOD) management and to compare the results with the terms proposed by International Dysphagia Diet Standardization Initiative (IDDSI). **Methods**: This research was approved by ethical committee. 60 speech therapists, who work with NOD, sorted five commercial drinks from thinnest to thickest to match IDDSI levels 0 to 4 and classified each consistency. **Results**: Most subjects (76.66%) sorted properly. Terminologies were divergent at all levels. Level 0 (IDDSI - thin) was named by most participants as LIQUID, level 1 (IDDSI - slightly thick) was referred as semi-thickened liquid, level 2 (IDDSI - mildly thick) as thickened liquid, level 3 (IDDSI - moderately thick) was named as honey and level 4 (IDDSI - extremely thick) was termed pasty by most subjects. Reduced number of participants used terms in accordance to IDDSI, and the lower the time of action in dysphagia, the better the index of correct answers to the standardized terminology. None of the subjects named the five IDDSI levels correctly. **Discussion/Conclusion**: Professionals were assertive in sorting the progression of drink, from the thinnest to the thickest. The research evidenced the low level of use of IDDSI and the diversity of terminologies used by speech therapists. This could hinder interdisciplinary communication and increase the risks of inappropriate use of consistency by patients, with impact on the swallowing dynamics and the safety and efficiency of their feeding.

Key Words: Deglutition, Deglutition Disorders, Terminology, Viscosity, Speech Therapy

INTRODUCTION

Swallowing transports food bolus from the mouth to the stomach preventing the entry of substances into the airway (1). Neurological changes can alter this process (1) and any characteristic that hinders the swallowing safely and efficiently is classified as dysphagia,

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recognized by the World Health Organization within symptoms involving the digestive system (2–3).Neurogenic oropharyngeal dysphagia (NOD) incidence varies from 15 to 84%, including older people, neurodegenerative diseases, strokes and traumatic brain injury (2, 4-6)

Rehabilitation includes direct therapy using food supply and indirect therapy performing sensorimotor exercise, maneuvers and postural changes (7) and the modification of food characteristics, such as texture, consistency, taste and temperature of foods and drinks (7-11). This approach has some peculiarities regarding hospitalized patients. To this population, the intervention begins as soon as the patient's vital signs are reestablished by the attending medical team. The intervention with hospitalized patients must be performed with the highest possible frequency. Liquids are related to laryngeal penetration (8) and to promote safe and efficient swallowing are considered homogeneous and thick diets (8, 9).Thickened beverages compensate deficits, reduce aspiration risk and improve swallowing parameters in neurological patients (2,3,13–16). However, increase in viscosity turns oral and pharynx transit longer (2), raise chances of food residues (2,15) and demand greater tongue pressure when swallowing (2,17). Liquid must to be thickened in the exact viscosity to improve safety of swallowing for each patient, since very thin liquids can be as detrimental as the thickened excessively (18) and the correct selection depends on the evaluation findings (19).

Currently, it is understood that the standardization of terminology to identify consistencies is relevant to guarantee the efficiency of treatment (3,20–22) both for patients seen at their homes and for those in hospitals. Internationally, several standardized terminologies are used (23–26), with emphasis on National Dysphagia Diet (NDD) (27) and International Dysphagia Diet Standardization Initiative (IDDSI) (28). NDD was published in 2002 by the American Dietetic Association in order to establish standard terminology and practical applications of dietary texture modification in dysphagia and establishes 4 levels for liquid foods (27). IDDSI was proposed in 2016 with the aim of developing standardized terminology at a global level to describe drink and food consistencies used for individuals with dysphagia. It presents 8 levels of consistency and proposes simple methods of measuring consistencies (https://iddsi.org/framework/drink-testing-methods/) using syringe, fork and spoon (28).

The lack of standardization of consistency nomenclature generates risks to the patient (3,20, 29). Especially for those patients who are hospitalized. They receive treatment by different professionals and the use of standardized nomenclature decreases the risks of misconducts. Viscosity of thickened liquids is often judged subjectively and described using terms such as syrup and honey (29). The prescriptions involving viscosity and texture should allow efficient communication between professionals (3,20, 29) focusing on the approach of multi professional teams at hospitals.

Speech therapists ought to know and use the standardization of viscosity nomenclature otherwise their practice may generate risks to the patients. In this way, the present study aims to verify ability of speech therapists to identify, sort and nominate different consistencies used in NOD management and to compare the results with the terms proposed by Dysphagia Diet Standardization Initiative (IDDSI).

METHOD

This is a cross-sectional descriptive and analytical study. It was approved by Ethic Committee (82752918.3.0000.5064 – Annex B). The sample consisted by speech therapists who work with NOD. These professionals were contacted by e-mail, phone and in person. A total of 114 participants were contacted and invited to compose the sample, however 65 accepted. As criteria to include to this study, the participants should work with NOD. There were excluded participants who would not fulfill the questionnaire or declared later that they do not exactly work with NOD.

Data were collected at their workplace and participants were informed by this study aims and signed consent terms to participate (Appendix B). The questionnaire investigated sample characteristics as age, gender, whether work with NOD or not, time of professional work activity with dysphagia, their workplace and population served.

The sorting and naming tasks were initially explained for each participant and the 5 drinks presented simultaneously in small portions arranged in colored disposable cups, but without increasing or decreasing order of consistencies. Participants were instructed to sort drinks from the thinnest to the thickest viscosity and write at blank spaces the terminology they would use to describe the consistencies presented. Materials available to participants were watercolor pens (green, blue, purple, grey and pink), 10 ml syringe without needle and plunger, stopwatch, spoons and forks. Participants were allowed to manipulate the samples if they wanted to. Five levels were considered to be used, from 0 to 4. To ensure the presentation of the same viscosity, only industrialized products were used. They were: Mate Tea (Chá Mate Leão®) level 0, Mango Juice (Summer Fruit®) level 1, yogurt strawberry flavor (Itambé®) level 2, Chocolate syrup (Ice Cream®) level 3 and strawberry flavored yogurt (Danoninho®) level 4. Each beverage was previously framed in the levels through the

IDDSI method using syringe and stopwatch (30). As the participants would finish the questionnaire, they received an IDDSI primer in order to encourage the use of IDDSI standardization in clinical practices. Linear regression was performed using Microsoft® Excel® to Office 365 MSO, version 1906. The statistically significant correlation was interpreted as follow correlation coefficient; 0.00 to 0.10- negligible correlation; 0.10 to 0.39- weak correlation; 0.40 to 0.69- moderate correlation; 0.70 to 0.89- strong correlation and 0.90 to 1.00- very strong correlation (30).

RESULTS

Sixty-five questionnaires were analyzed to characterize the sample. A total of 5 participants were excluded because they did not work with NOD. The sample, therefore, was composed of 60. From this total, 33 (55%) participants informed to work with NOD only and 27 (45%) mentioned to work with NOD and mechanic oropharyngeal dysphagia. Their ages varied from 21 to 54 years an average of 33.8 years and they were mostly female 56 (93.3%). Their time of practicing with NOD varied from 1 month to 20 years with an average of 5 years and 4 months. The number of participants per years of experience as well the age distribution per years of experience is comparable (Table I). Data depicted in table I indicate a moderate inverse correlation between years of experience in NOD and assertive answers. A correlation coefficient between 0.40-0.69 was considered moderate (30).

Table I – Correlation between years of experience in dysphagia and assertive answers.

Years of experience	Participants (n)	Age	Assertive answers	F	p	R^2
< 1	11	30.8±7.7	9	5.596	0.0989	0.6510
2-3	15	29.8±7.0	7			
4-5	12	35.0±6.7	3			
6-9	11	37.4±6.7	0			
10-20	11	37.5±3.1	0			

Legend: *F= Frequency; p= p-value; R²= correlation coefficient*

Home care was the main workplace described (61.66%) followed by hospitals (48.33%). There was no difficulty in identifying the viscosity of level 0. Most speech therapists

(76.66%) identified and sorted consistencies from 0 to 4, from the thinnest to the thickest correctly.

Table II presents viscosity sorting data from the thinnest to the thickest. Most participants 49 (81.66%) properly sorted the levels 1 and 2. At level 3 and 4, 57 (95%) sorted properly.

Table II - Analysis of sorting the food consistencies from the thinnest to thickest

Levels	Correct n (%)	Incorrect n (%)
0	60 (100)	0 (0)
1	49 (81.66)	11 (18.34)
2	49 (81.66)	11 (18.34)
3	57 (95)	3 (5)
4	57 (95)	3 (5)

Concerning the terminology used by speech therapists, there was agreement between 45 participants (75%) in the terminology designated to level 0. For level 1, 24 different terms were presented, for level 2 were 25 terms, for level 3 were 23 and for level 4 participants used 18 terms. The analyses of the terminologies were grouped for being similar, as shown in table III. The findings show the use of different terminologies for the same viscosity.

Table III - Terminologies used for food consistencies

Levels	Number of Terms	Terms	Subjects
Level 0	3	Liquid;	45
		Thin liquid;	5
		Fine liquid;	10
Level 1	24	Liquid *(liquid; thin liquid)*	13
		Semi-thickened liquid *(semi-thickened liquid; liquid slightly thickened; thickened liquid; very slightly thickened; slight thickened; slightly thick; liquid thickened thin;*	22

		liquid lightly thickened; thick liquid;slightly thickened; semi-liquid)	6
		Thickened liquid *(thickened liquid; coarsened liquid; very thickened liquid)*	10
		Nectar *(nectar; thickened liquid nectar; liquid nectar;)*	3
		Honey *(honey; almost honey)*	6
		Thin pasty *(thin pasty; liquid pasty; liquid thin pasty)*	
		Liquid *(liquid; thin liquid)*	7
		Semi-thickened liquid *(semi-thickened liquid; semi-liquid; slightly thick; liquid slightly thick; liquid little condenseded;liquid lightly condenseded; very lightly thickened)*	9
Level 2	25	Thickened liquid *(thickened liquid; moderately thickened liquid; pasty liquid; liquid extremely thickened; moderately thickened; medium thickened; liquid thickened; coarsen liquid; thick)*	22
		Nectar *(nectar; liquid nectar)*	11
		Honey *(honey; thickened liquid honey; liquid honey)*	6
		Thin pasty *(thin pasty; fine pasty)*	5
		Pasty liquefied; *(pasty liquefied; liquefied)*	2
		Thickened liquid *(Thickened liquid;moderately thickened liquid; thick liquid; coarsened liquid; thick; moderately thickened)*	6
Level 3	23		5
		Nectar *(nectar; liquidnectar, pastynectar)*	
			25
		Honey *(honey; liquid honey; pasty like honey; thin pasty honey)*	19

		Pasty *(pasty; thin pasty; semi-pasty; liquid pasty coarsen; liquid pasty; medium pasty)*	3
		Pudding *(pudding; thickened liquid pudding)*	
Level 4	18	Extremely thickened	2
		Pasty *(pasty; coarsened pasty; liquid pasty; homogeneous pasty; pasty firm; pasty exclusive; semi-pasty; pasty like yogurt; pureé; pasty pureé; smooth pureé)*	45
		Homogeneous	1
		Pudding *(pudding, liquid pudding; pasty pudding)*	10
		Solid *(solid; pasty solid)*	2

Level 0 (IDDSI - thin) was named by most participants as LIQUID, level 1 (IDDSI - slightly thick) was referred as semi-thickened liquid, level 2 (IDDSI - mildly thick) as THICKENED LIQUID, level 3 (IDDSI - moderately thick or liquidized) was named as HONEY and level 4 (IDDSI - extremely thick or pureed) was termed PASTY by most subjects. Reduced number of participants used terms in accordance to IDDSI, level 0 being nominated by 5 subjects (8.33%), levels 1, 2 and 4 by 2 professionals each (3.33%) and level 3 by 1 professional (1.66%). None of the subjects named 5 IDDSI levels correctly.

DISCUSSION

It was possible to verify that the lower the time of action in dysphagia, the better the index of correct answers to the standardized terminology. This data indicated that professionals with longer training are not keeping up to date and tend to use their own unified terminology to designate the consistencies of drinks. These practices may contribute to increase the difficulties to swallow instead to help the NOD patients.

Since IDDSI is available for free on the internet (https://iddsi.org/framework/drink-testing-methods/), there is no justification for the lack of access and use of such standardization of terminology.

The need for proper use of consistencies for each patient (7-11, 13-16, 18), as well as the standardization of terminology favoring swallowing safety and efficiency (3, 20-22), is also evident. It is imperative to update the professional about terminology standardization in order to maintain the quality of care and patient safety.

Most speech therapists (61.66%) reported to work on home care, where professionals must train and guide family and caregivers in accordance with diet adequate viscosity. The use of IDDSI benefits this process, in addition to the standardization of terminologies, it also proposes simple and accessible viscosity measurement methods (31). Professionals also reported working in hospitals (48.33%), where the use of standardized terminology would facilitate communication between different sectors, such as speech therapy, nutrition and food preparation (20).

The inadequate use of terminology observed in this study could hinder communication between professionals in hospitals or other rehabilitation services, since non-standardized terms such as syrup, yogurt, thickened or pasty liquid lead to be not accurate inducing the consumption of inadequate consistencies. The diversity of terminology could make it difficult for other professionals, patient, or caregiver to understand and obtain the desired consistency. The lack of a nomenclature agreement among professionals, as evidenced by this research, can lead to different interpretations in food viscosity prescriptions and health damages to patients (3, 20, 29).

When analyzing the ability to sort the presented consistencies, most of the subjects performed the drink progression properly, from thinnest to thickest. It was possible to infer that visualization, side by side, facilitated sorting the drink viscosity, and the correct viscosity identification is extremely relevant because it allows the professional to establish the level to be used (23).

Regarding the terminologies used by the speech therapists, the present study indicated a great diversity among the participants. Concerning level 0, there was agreement between 45 participants (75%) in the terminology designated, as in other studies in which professionals were also assertive in naming the extremes of consistency (20, 29). It was possible to observe divergence of nomenclature at all levels, especially level 2, which presented 25 different terminologies. The absence of a standardization that guides both the preparation and naming of drink and food consistencies results in a variety of nomenclature in clinical practice (3,20,21,29) while the unification of terminology provides patient safety and treatment efficiency (3,20,22).

When professionals use their own unified terminology, there is a high possibility of patient misuse of consistency leading to crucial interferences in the physiology of swallowing. There may be increased risk of aspiration (2, 3, 12–16), modification in oral and pharyngeal transit time (2), presence of pharyngeal stasis (2, 15) and changes in tongue force required for ejection of the bolus (2, 17).

Bolus manipulation is a primary treatment strategy in the management of oral-pharyngeal dysphagia (16). The modification of food characteristics as a rehabilitation strategy, such as texture and consistency (8, 9, 13-16), is one of the responsibilities of speech therapists and the proper use of terminology is an essential attribute for this professional.

Due to the diversity of terms found in this research, it is supposed that most of the professionals who participated in the study were unaware of IDDSI. It is suggested that the standardization of IDDSI terminologies be promoted through courses, congresses and publications that encourage the updating of the professional, based on the relationship between consistency and variation in the physiology of swallowing.

CONCLUSIONS

Professionals were assertive in sorting the progression of drink, from the thinnest to the thickest.

The research evidenced the reduced use of IDDSI and the diversity of terminologies used by speech therapists who work with NOD. This could hinder interdisciplinary communication in hospitals, health services and also in the orientation of patients and caregivers, as well as increase risks of inappropriate use of consistency by patients, with impact on the swallowing dynamics, safety and efficiency of their feeding.

The study presented limitations due to the reduced number of participants and the restriction to professionals who work with NOD. It reinforces, therefore, the need for new research, aiming to verify and promote the use of standardized terminology.

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CHAPTER 5

LACK OF STANDARDIZATION IN COMMERCIAL THICKENERS USED IN THE MANAGEMENT OF DYSPHAGIA

CHAPTER 5

LACK OF STANDARDIZATION IN COMMERCIAL THICKENERS USED IN THE MANAGEMENT OF DYSPHAGIA[4]

Alessandra Salles Machado[a], Dominik Lenz[b] Rafael dos Santos de Souza[c], Rebeca Muniz Eugênio[c], Tadeu Uggere de Andrade[b], Tiago Costa Pereira[a], Denise Coutinho Endringer[b]

[a] Department of Speech Therapy, Universidade Vila Velha, Vila Velha, Brazil; [b]Department of Pharmacy, Pharmaceutical Science Graduate Program, Universidade Vila Velha, Vila Velha, Brazil; [c]Speech Therapist/Universidade Vila Velha, Vila Velha, Brazil

Short Title: **Analysis of commercial thickeners**

Keywords: Deglutition; Deglutition disorders; Food; Swallowing disorders; Thickeners; Viscosity

Abstract

Introduction: Oral feeding safety is necessary to provide nutrition, hydration and eating pleasure for patients with dysphagia. Commercial thickeners are prescribed for these patients to change food viscosity and may alter the proper preparation of modified food. ***Objective:*** Analyze composition, employed terminology, preparation instructions, recommended amount, and weight of provided measuring spoons, nutritional information and viscosity of 7 commercial thickeners. ***Methods:*** The sample comprised all thickeners from different brands available in Brazil, named A to G. Products were submitted to viscosity analysis using viscometer and the *Dysphagia Diet International Standardization Initiative* (IDDSI) test. Samples were prepared with mineral water (25°C) and with the amount of thickener recommended to obtain intermediate viscosity (level 2) according to the manufacturer's instructions. ***Results:*** Products B, C and E presented similar composition. Manufacturer’s information about the amount and preparation procedure, time, temperature and base liquid

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were incomplete. Viscosity tests revealed that thickener C was basically solid while D displayed results out of the desired viscosity level. ***Conclusions:*** The study showed differences in components and viscosity, beyond the lack of label details. There was no established correlation between viscosity classifications provided by National Dysphagia Diet (NDD) and Dysphagia Diet International Standardization Initiative (IDDSI).

Introduction

The feeding process involves much more than the caloric intake. It provides one of life's greatest pleasures and involves features such as appearance, flavor and consistency of food. Swallowing is a complex mechanism that occurs successively and automatically [1]. Dysphagia is a set of symptoms that occur because of an underlying disease. It is defined as any difficulty in transporting food from mouth to stomach [2, 3]. Oral feeding safety is one of the therapy's purposes in patients with dysphagia, providing nutrition, hydration and eating pleasure. It is recommended to change food viscosity [3, 4], by appropriate increases in the viscosity of liquids [5] and commercial thickeners are usually prescribed for these patients.

Thickeners experience different influences that may alter the proper preparation of modified food. Products containing cornstarch, raw or modified forms, will suffer salivary amylase effect, decreasing the viscosity of thickened fluid even when gums are added [6, 7]. The reduction occurs within the first 10 seconds, representing the oropharyngeal swallowing phase. Saliva can also contaminate the thickened beverage of a glass and after 10-15 minutes, viscosity is reduced to less than 1% of its original value [6, 7]. The pH of base fluid can interfere in the action of amylase on the thickened beverage [8]. Different base liquids require different amounts of thickener to achieve the same viscosity [9–16], but many manufacturers do not consider this interaction and recommend a single amount of product regardless of the base liquid that will be thickened [8].

Regarding temperature effects on the viscosity of samples, lowest temperatures result in higher viscosity [8, 9, 17–21]. As for the variable time, viscosity increases if the waiting time after preparation is prolonged [8, 9, 17, 20]. Sensory information related to thickened drinks must be also considered, once modifications in taste, smell or appearance of fluids can reduce daily oral intake [10].

Manufacturer's instructions described in thickener labels do not include the variables base liquid, temperature and time [8], increasing the possibility of inadequate preparation and consume of the food with the inappropriate viscosity, which should interfere in the swallowing physiology, generating risks for patients [22–25].

Another variable that may impact the management of dysphagia is the lack of standardization in viscosity terminology used in clinical practice and scientific literature [26]. Some countries, including the United Kingdom, Japan, Ireland, New Zealand, Australia and Israel, use standardized terminology [27, 28]. A similar standardization was introduced in the United States by the National Dysphagia Diet Task Force (NDD) [29]. These terminologies describe viscosity's level and present some quantitative forms to identify food's texture [27, 29]. In 2016, the Dysphagia Diet International Standardization Initiative (IDDSI) established new nomenclature for solid and liquid consistencies [30]. International standardization improves safety, reliability and quality of food and reduces costs associated with waste and errors [27]. In addition, such standardization increases the efficiency of communication between staff members both within and between health institutions.

Considering the requirement of thick liquids during dysphagia treatment, the influences that may occur in the preparation of thickened beverages and the need for detailed information on product labels, the objective of this study was to analyze 7 commercial thickeners in terms of composition, employed terminology, preparation instructions, nutrition values, and viscosity.

Methods

Ethical Statement

This research did not require submission to the analyses of Ethics Committee because there were no interventions practiced with humans or data collected from them. This research was conducted as the World Medical Association Declaration of Helsinki states.

Samples

All powder thickeners available in Brazil, labeled A to G, were purchased in drugstores.

Viscosity analysis

Thickeners were submitted to viscosity analysis at an University Chemical Engineering Laboratory. The following materials were used: Rotational Viscometer Quimis® (Q860 M21 model 11110340), Shimadzu Analytical Scale balance (Model AUY 220, D-308 520 276 series), Uniglas® (100 and 600 ml) Beckers, Incoterm® thermometer, Campinho® mineral water (pH 5.74, temperature 25°C), aluminum spoon and fork, 7 measuring spoons provided by the thickeners' manufacturers, 10-ml syringes with a Luer central slip nozzle, and a Technos Yp2151 chronometer.

Samples were prepared with mineral water at room temperature (25°C) and the amount of thickener recommended to obtain intermediate viscosity (level 2) mixed with a tablespoon or fork according to the manufacturer's instructions. As the results obtained by the viscometer showed heterogeneous centipoise (cP) values based on NDD, data were compared to IDDSI classification, by submitting samples to the flow of liquid test [20].

Statistical analysis

This step consisted in a descriptive study of analyzing labels information, viscosity and terminology comparison (NDD and IDDSI). The products labels were analyzed considering composition, employed terminology and preparation instructions. The values obtained were compared with viscometer results.

Results

The ingredients of the 7 investigated products are described in Table 1. Regarding composition, products B, C, and E presented only modified cornstarch. Thickeners A and F added maltodextrin to modified cornstarch and only D and G used at least one type of gum as an ingredient.

All the 7 products divided viscosity into three categories but only thickeners F and G used the terms in accordance with the NDD (liquid, nectar, honey and spoon-thick) [29]. Terminology described in A, B, C, D and E does not follow any official terminology.

Table 1. Ingredients described on the label

Ingredients	Thickener						
	A	B	C	D	E	F	G
Modified corn starch	X	X	X	X	X	X	
Maltodextrin	X			X		X	X
Xanthan gum				X			X
Tara Gum				X			
Guar Gum				X			

Label instructions for preparation are presented in Table 2. Information related to time to reach the desired consistency, appropriate base liquids, temperature, taste and appearance were absent or incomplete.

Table 2. Labels instructions

Instructions/variables	Thickener						
	A	B	C	D	E	F	G
Time	30’s to 1 min.	2 min.	15’s to 30’s	Few minutes	____	30’s to 1 min.	____
Base liquid	Water, juice or milk	____	____	____	____	____	Various foods.
Temperature	Hot or cold	____	Hot or cold	Hot, cold or frozen	____	____	Hot or cold
Taste /appearance	Does not change the color or taste	____	____	Does not change flavor	____	____	Does not change the color or smell

Table 3 compares NDD and IDDSI classifications with cP values and flow test results. Honey viscosity ranged between IDDSI levels 1 and 4, which are characterized by liquid flow (levels 1 - 3) and no flow (level 4). Four thickeners fitted level 3 (A, C, F, and G).

Table 3. Comparison between NDD and IDDSI

Classification	Thickener						
	A	B	C	D	E	F	G
Viscosity (cP)	610	1,027	774	1,297	384	1,037	635
NDD	Honey	Honey	Honey	Honey	Honey	Honey	Honey
IDDSI	3	1	3	2	4	3	3

Table 4 presents the nutritional information described on products label for a presumed daily consumption of 1,000ml at the honey level (1,000cP), including energy, carbohydrates, fiber and sodium. Only thickeners B and G presented fiber information, and G provides 37.68% of the daily values (DV) consumption. Products A, F and G contained sodium and G showed the higher amount, 17.01% DV. Product E reached high levels for carbohydrates (44.45% DV) and calories (27.45% DV).

Table 4. Nutritional information for daily consumption (1,000 ml/1,000cP)

Nutritional information	Thickener A	B	C	D	E	F	G
Amount (g)	98.20	38.90	67.50	33.90	156.9	65.00	37.70
Energy value (Kcal)	368.25	136.92	243	118.65	549.15	242.45	100.53
DV*	18.41%	6.84%	12.15%	5.93%	27.45%	12.12%	5.02%
Carbohydrates (g)	90.83	34.23	54.00	29.66	133.36	60.45	25.13
DV*	30.27%	11.41%	18.00%	9.88%	44.45 %	20.15%	8.37%
Dietary fiber (g)	--	0.38	--	--	--	--	9.42
DV*	--	1.52%	--	--	--	--	37.68%
Sodium (mg)	181.85g	--	--	--	--	113.10	408.41
DV*	7.57%	--	--	--	--	4.71%	17.01%

Legend: *DV: Daily values based on a 2000-Kcal diet

Discussion

Composition

Modified cornstarch was prevalent in the investigated products, followed by maltodextrin, in accordance with previous literature reports [17]. Only thickener D contained guar gum and xanthan gum, despite literature states advantages of xanthan gum-based thickeners in comparison with the cornstarch-based ones[24, 31]. Products modified with gum retain the viscosity better than those with added starch after mouth processing [31]. Considering the components, thickener G is considered a good option due to the absence of modified cornstarch.

Terminology

Only products F and G described viscosity according to the classification of National Dysphagia Diet (liquid, nectar, honey and spoon-thick) [29], and the nomenclature proposed by other manufacturers does not coincide with any standardization efforts [27, 29, 30]. In 2016, the International Dysphagia Diet Standardization Initiative (IDDSI) [30] was implemented to describe thickened liquid consistencies, but neither one of the products followed it. It was possible to identify products F and G as the most appropriate in terms of employed terminology, since they followed the nomenclature recommended by NDD.

Label instructions

All labels of thickeners reported the needed amount and method of preparation; however, they have not provided enough details of how to produce the desired viscosity. Regarding the time employed during the preparation procedure, it was observed that thickeners E and G have not provided any information while the other products provided insufficient information, ignoring that the viscosity of thickened product will continue increase after mixing [8, 9, 17, 20, 32-34]. Information involving base liquid was found on the label of thickener A, which reported that water, juice and milk could be added however, no statement that results may vary depending on the liquid used is present. The other thickener labels did not address changes in the effectiveness of the product according to the base fluid. The literature describes the influence of base liquid composition and its physical and chemical properties in the viscosity of the thickened beverage, such as water, tea, coffee and fruit juices [8, 9, 20]. Regarding temperature, thickeners did not provide detailed information about the effect of this variable on the rheological proprieties. The labels of thickeners A, C and G noticed that the product can be used with hot or cold food, and thickener D mentioned that thickened food may be heated, chilled or frozen without modifying viscosity. Studies have shown effects of temperatures between 10 and 20°C on the viscosity of samples, with lower temperatures resulting in higher viscosities [8, 17, 18]. Three labels (A, D and G) stated that the product would not change beverage color, smell or taste, although literature indicates that thickening agents affect appearance and texture of the base liquid [35, 36]. Overall, the present study observed that the information on thickener labels is either incomplete or imprecise. Only thickener A provided full information, but without details that would ensure the correct use of the product.

Viscosity

Thickeners used in this study reached varying viscosity levels (382 to 4,288cP). Thickeners A, B, E, F and G produced honey viscosity, product D produced a spoon-thick viscosity, and the use of thickener C resulted in a solid sample. These data coincide with literature results [37] that found divergence in the viscosity of commercial thickeners. Such high viscosity variety leads to different patterns of swallowing, since interferences in time of swallowing, tongue pressure, presence of pharyngeal residues and risk of aspiration are demonstrated [17].

Considering that IDDSI provides more levels for thickened liquids (0=thin, 1=slightly thick, 2=mildly thick, 3=moderately thick, 4=extremely thick) than NDD (liquid, nectar, honey and spoon-thick) [30], this study tried to establish a correlation between these two terminology classifications. Tests conducted according to the IDDSI methodology showed discrepancies between the examined thickeners, which were characterized at different levels with no direct correspondence of cP values. Thickeners B and D produced final beverages classified as levels 1 and 2, respectively. Thickener E fell into category 4 due to non-flow or a drip time of 10 seconds as the sample was solid, demonstrating the ineffectiveness of the product and the possibility of unsafe feeding process. It was not possible to correlate the methodologies (viscometer and flow) and naming standards used (NDD and IDDSI). The centipoises (cP) values of honey-viscosity products were not always equivalent to the levels presents in the IDDSI. However, there was a predominance of level 3, "moderately thick".

Nutritional values

The nutritional values of thickeners may interfere with dietary calorie intake and body weight in patients with oropharyngeal dysphagia. The results obtained confirm this statement since values of energy intake for a daily consumption of 1,000ml at 1,000cP, varied from 5.02% to 27.45% of calories daily value (DV). All the products described presence of carbohydrates and fiber was observed only in thickeners B and G. However, thickener D contained xanthan gum, guar gum and tara gum and should describe fibers on the nutritional information; thus suggesting low levels of these components. The amounts of sodium were not standardized, being present only in products A, F and G indicating that, for patients with significant sodium intake limitations, thickener consumption could have an impact [38]. Overall, thickener G was the most nutritionally suitable, presenting lower values for calories, carbohydrates and sodium, besides higher fiber amount.

Conclusions

This study showed differences in components**,** employed terminology, preparation instructions and recommended amounts of 7 commercial thickeners. There was a lack of detail regarding time of preparation, base liquid and temperature, which may interfere on the preparation conditions and in the final product. There was no established correlation between viscosity classifications provided by NDD and IDDSI.

Statement of Ethics

This study does not involve any human or animal testing. This research did not require submission to the analyses of Ethics Committee because there were no interventions practiced with humans or data collected from them. This research was conducted as the World Medical Association Declaration of Helsinki states

Disclosure Statement

The authors declare that they do not have any conflict of interest.

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Author contributions

A.S.M.: contributed with the acquisition, analysis, interpretation of data for the work and drafting the work and revising it critically for important intellectual content; D.L. and R.S.S.: contributed with the acquisition and analysis of the data; R.M.E.: contributed with interpretation of data for the work and drafting the work and revising it critically for important intellectual content; T.U.A and T.C.P.:contributed with interpretation of data for the work and revising it critically for important intellectual content; D.C.E.: contributed with designing the work and drafting the work and revising it critically for important intellectual content. The entire authors approved the version to be published.

Informed consent

The consent were not applied in this work.

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CHAPTER 6

PECTINS FROM *CITRUS LEMON* AND *CITRUS SINENSIS:* NEW THICKENER FOR DYSPHAGIA MANAGEMENT

CHAPTER 6

PECTINS FROM *CITRUS LEMON* AND *CITRUS SINENSIS:* NEW THICKENER FOR DYSPHAGIA MANAGEMENT[5]

Alessandra Salles Machado, Bruno Oliveira Gomes, Wanderson Romão, Ana Carolina Pinnoti, Tayná Barbosa Paulino, Camila Augusto Perussello, Jesus Maria Frias Celayeta, Denise Coutinho Endringer

ABSTRACT

The stability of thickened liquids is critical in dysphagia management. Variables as components, time, base liquid and temperature are determinant to achieve a stable desired viscosity. This work aimed to develop a pectin-based thickener that offers more stability to thickened beverages for dysphagic patients. Pectin was extracted from Rutaceae fruits, *Citrus sinensis* and *Citrus lemon*, and underwent psychochemical analyses and chemical composition determination. The two pectins were added to four fluids (mineral water, orange juice, instant coffee and whole milk) at different concentrations and temperatures (15, 25 and 50°C) and rheological assessments (viscosity and stability) were done from 0 to 120 minutes. The same procedure was repeated to xanthan gum and a commercial thickener considered as control. The degree of esterification of the two pectins was similar (89.21% versus 85.74%) and galacturonic acid levels reached respectively 56.81% and 63.41% with pectin's pH 4.29 for *C. sinensis* and 4.26 for *C. lemon*. The high resolution and accuracy of FT-ICR MS allowed the structural identification of 19 compounds, mainly mono, di, tri and oligosaccharides. Changes in temperature and use of xanthan promote unwanted viscosity variations. Formulations containing at least one of the two pectins were more stable than the samples containing only xanthan or commercial thickener. The use of *lemon* or *sinensis*

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pectin can be useful in reaching the desired stability of commercial thickeners for dysphagia management.

Keywords: Dysphagia; Thickeners; Pectin; Citrus; Viscosity.

1. Introduction

Feeding may be compromised by dysphagia, which involves alterations of swallowing phases and causes serious health risks (Dusick, 2003). Changes in the food's volume, viscosity, temperature and flavor (Pagno, Souza, Flores & Jong, 2014) are recommended for these patients since properties of the bolus, such as viscosity and consistency (Cichero, Jackson, Halley & Murdoch, 2010), interferes in aspiration risks and pharyngeal food retention (García, Raurich, Santamaría & Mora, 2016).

Viscosity changes may have safety implications when the desired parameter is not reached (Garin et al., 2014) and the stability of thickened liquids is critical in dysphagia management (Hanson, O'Leary & Smith, 2012). Variables as ingredients of the commercial thickener, time after preparation, base liquid and temperature are determinant for the desired viscosity of thickened beverages to be achieved and to remain stable (Hanson et al. 2012; Garin et al., 2014; Garcia, Chambers, Matta & Clark, 2005; Pagno et al., 2014; Cichero & Lam, 2014). After preparation, gum-based thickeners are more stable over time than their corn-based equivalents (Hanson et al. 2012). The base liquid also impacts the final viscosity of thickened beverages (Garin et al., 2014; Garcia, Chambers, Matta & Clark, 2005). Orange juice and milk produce higher viscosity compared to thickened water (Garin et al., 2014), for example. Milk, orange, apple and grape juice thickened with guar gum-based product increased viscosity at lower temperatures (Pagno et al., 2014), confirming that cold liquids tend to be more viscous than at room temperature or heated and temperature should also be considered (Cichero & Lam, 2014). The presence of sodium in thickeners composition is another factor that impacts on dysphagic patients' health (Almeida, Germini, Kovacs & Soares, 2013).

The variable rheological behavior of beverages thickened with commercial thickeners justifies the investigation of pectin, a natural product with gelling properties, as a thickener in dysphagia management products.

Pectin is a heteropolysaccharide whose predominant residue is galacturonic acid (GalA), occurring in parts as methoxy esters, while a certain amount of neutral sugars may be present as side chains (Kertesz, 1951). Pectins have been widely used as texture modifiers, stabilizers, thickeners and gelling agents in different products (Mirhosseini & Amid, 2012), but not specifically for dysphagia management products. After more than 200 years since the discovery of pectins, their properties are still widely studied due to the lack of homogeneity of its physical and chemical structure (Chan, Choo, Young & Loh, 2017), but in fact, gel formation is the most important property of pectins (Colodel et al., 2019).

Pectin yield and molecular characteristics (degree of esterification, galacturonic acid content, molar mass and rheological behavior) vary according to the source, environmental factors and conditions of extraction (Venzon et al., 2015; Petkowicz, Vriesmann & Williams, 2017). The rheological behavior and gelling properties of pectins have been deeply investigated, especially involving high-methoxylated (methoxylation degree above 60%) demonstrating greater ability to form gels (Do Nascimento, Simas-Tosin, Iacomini, Gorin & Cordeiro, 2016; Colodel, Vriesmann & Petkowicz, 2019). Modified pectin presents a lower degree of esterification, which influences its rheological properties, mainly by reducing its viscosity (Venzon et al., 2015). Wei et al. (2020) investigated the use of polysaccharides, including high-methoxylated pectin (73%), as viscosity stabilizer in thickened beverages and reached positive results at different pHs.

Pectin are mostly extracted from citrus peel (85.5%) (Ciriminna, Chavarría-Hernández, Hernández & Pagliaro, 2015), such as C*itrus lemon* (Azad, Ali, Akter, Rahman & Ahmed, 2014; Sebaoui, Moussaoui, Kadi, Michaud & Delattre, 2017), *Citrus maxima* (Sotanaphun et al., 2012); Chaidedgumjorn et al., 2009), navel orange (Liu, Shi & Langrish, 2006) and *Citrus ponkan* (Colodel et al., 2019).

The purpose of the present work is to study the rheological properties and stabilization behavior of a new thickener based on pectin extracted from *Citrus sinensis* and *Citrus lemon* to be applied in beverages used in dysphagia management.

2. Methods

2.1 Standards and Chemicals

Galacturonic acid was purchased from Sigma Aldrich® (St. Louis, MO, USA). Other reagents used (hydrochloric acid, ethanol, and acetone) were of analytical grade. Xanthan gum was purchased from Synth, while commercial thickener (Thicken up Nestle Nutrition®) and instant coffee (Nescafe Gold Blend®) were purchased from Nestlé. Mineral water used in the viscosity experiment was purchased from Evian Natural®. Orange juice was purchased from Jaffa Gold® and whole milk from Tesco Fresh Organic®. The water used in the pectin extraction was first bi-distilled and then deionized (Millipore, USA). All the other chemicals used were of analytical grade and were used without further purification.

2.2 Collection and identification of plant material

Samples of the fruits of *Citrus lemon* (L. Osbeck) and *Citrus sinensis* (Rutaceae family) were harvested in July 2018, in a commercial farm in Venda Nova do Imigrante, ES, Brazil. The fruits were harvested in the maturity stage, based on external color.

2.3 Pectin extraction

The fruits were rinsed with tap water and dried. They were manually separated into flavedo, albedo and peeled fruits. The flavedo and peeled fruits were stored at -20°C and not used in the present work. The albedo was crushed. The crushed albedo (2.888g *C. lemon* and 3.264g *C. sinensis*) was submitted to pectin extraction as previously described by Sotanaphun et al. (2012) with modifications. Briefly, the albedo was dried at 50°C for 12 h and underwent two sequential water baths (pH 3.5) for 3h at 80°C. The filtered liquid was rotovap evaporated to 10% of its volume and then centrifuged (874g, 3 min) for particle precipitation. The remaining liquid was adjusted to pH 3.7 with hydrochloric acid and added of 95% ethanol 1:2. After centrifugation (2675g, 8 min) the precipitated pectin was washed with ethanol 95%, oven-dried at 50°C for 12 h, then ground in a ball mill. The yield of pectin was calculated on a dry basis.

2.4 Moisture content

To determine the moisture content of the dried ground material, the samples were weighed, heated in an oven at 105°C and cooled in a silica gel desiccator to constant weight (Instituto Adolfo Lutz, 1985). The moisture content was calculated by:

$$Moisture\ content = \frac{D - W}{W} \times 100$$

where W is wet weight and D is dry weight.

2.5 Degree of Esterification

The degree of esterification (DE) was determined according to the methodology described by Pinheiro et al (2008). DE was calculated by:

$$DE = \frac{T_f}{(T_i - T_f)} \times 100$$

where T_i is the total mL of NaOH used for initial titration and T_f the total mL of NaOH used in final titration.

2.6 Degree of galacturonic acid

For the determination of the galacturonic acid content present in the extracted pectins, a 520 nm wavelength spectrophotometer with a D-galacturonic acid monohydrate standard was used according to the method proposed by Filisetti-Cozzi and Carpita (1991).

2.7 ESI (-) FT-ICR MS

For the analysis of the pectin from *C. lemon* and *C. sinensis*, 500 µL of pectin was dissolved in 500 µL of methanol. The methanolic solution was basified with 4 µL of NH_4OH (Vetec Fine Chemicals Ltda, Brazil). The mass spectrometer (model 9.4T solariX, Bruker Daltonics, Bremen, Germany) was set to operate in the negative ion mode, ESI(-), over a mass range of *m/z* 150–1250. The ESI(-) source conditions were as follows: a nebulizer gas pressure of 1.4 bar, a capillary voltage of 3.8 kV, and a transfer capillary temperature of 200ºC. The ion accumulation time was 0.010 s. The ESI(-)FT-ICR mass spectrum was acquired by accumulating 32 scans. The high-resolution spectra obtained ($m/\Delta m_{50\%}$ = 400,000-500,000; in which $\Delta m_{50\%}$ is the full peak width at the half-maximum peak height of m/z 400) at a mass accuracy of <1 ppm provided the unambiguous molecular formula assignments for singly charged molecular ions. Mass spectral data were acquired and processed using Data Analysis software (Bruker Daltonics, Bremen, Germany), and the elemental compositions of the compounds were determined by measuring the *m/z* values. The proposed structures for each formula were assigned using the Chemspider (www.chemspider.com) database (Oliveira et al., 2016).

2.8 Particle size distribution (PSD)

The particle size and polydispersity index (PDI) of *C. lemon* and *C. sinensis* pectins were determined by dynamic light scattering (DLS) (Zetasizer Nano-ZS 900, Malvern Instruments Co., LTD., United Kingdom). Measurements were taken after diluting the pectins 100 times in deionized water. All measurements were performed in triplicate at 25 °C and an angle of 90° with a DSL instrument (DSL, Nano Sizer, Malvern Instruments).

2.9 Viscosity measurements

The material used for the viscosity tests included a viscometer (Viscotech Myr VP1020), two types of pectin (extracted from *C. sinensis* and *C.lemon)*, xanthan gum, commercial thickener, mineral water, orange juice, whole milk and instant coffee. The concentration of the solutions was 4% and the experimental design is presented in Table 1. The experiments also included the control solution composed by the commercial thickener.

Table 1: Thickener development experimental design.

Code	*Lemon* pectin (%)	*Sinensis* pectin (%)	Xanthan gum (%)
L	100	0	0
S	0	100	0
X	0	0	100
LS	50	50	0
LX	50	0	50
SX	0	50	50
LSX	33.33	33.33	33.33

Measurements were performed at temperatures 15°C, 25°C and 50°C and at five distinct times: 0, 30, 60, 90 and 120 minutes after mixing the solution.

An exponential asymptotic model was chosen to represent the viscosity data:

$$Viscosity = Asym + (R_0 - Asym) \times e^{(-e^{lcr} \times t)}$$

where *Asym* is the upper asymptotic value of the model, R_0 is the initial viscosity [mPa.s], *lrc* is the natural logarithm of the rate constant and t is the time [min] after mixing in minutes.

The model fitting was performed using R, a free software environment for statistical computing and graphics (R Core Team, 2017).

2.10 Statistical analysis

Statistical analyses were performed using the free software R. Data were expressed as the mean and standard deviation, and statistical comparisons were carried out using analysis of variance (ANOVA) followed by a Tukey post-test. The level of significance was identified as $p<0.05$.

3. Results and discussion

3.1 Yield of pectin and moisture content

The pectin extraction using water bath at 80ºC and pH 3.7 yielded 4.25% for *C. sinensis* and 4.91% for *C. lemon*. Pectin yield may be affected by different variables, such as *Citrus* species, temperature, time and pH conditions, with an increasing yield at lower pHs (Liu et al., 2006; Colodel et al., 2019). Applying similar methodology for *C. maxima*, water extraction at 80ºC and pH 4.5, Sotanaphun et al. (2012) obtained a yield of 4.40%. The adaptation of the extraction method prioritized reducing the steps to favor industrial production as well as optimizing the product viscosity, and the yield obtained was similar to that of the original method. Chaidedgumjorn et al. (2009) reached 8.89-10.87% for *C. maxima* using water extraction, ammonium oxalate solution (pH 6.5) and significantly longer extraction (10h). For *Citrus lemon* pectin, Azad et al. (2014) achieved higher values using only distilled water, 10.83%, but the higher pH used during the extraction (pH 7) should compromise esterification levels and the final viscosity. For microwave and Soxhlet extraction of navel orange, Liu et al. (2006) reached lower values, 1.60-2.00% (pH 2.0). According to Sotanaphun et al. (2012), higher yield and viscosity are obtained at lower pH values, however at the expense of lower galacturonic acid content, indicating a mixture of pectin with other constituents.

The values found for moisture content, 11.17% for *C. sinensis* and 10.16% for *C. lemon*, are comparable with those reported by Azad et al. (2014), 11.49-13.40%.

3.2 Degree of esterification, galacturonic acid and pH

The degree of esterification (DE) of *C. lemon* (85.74 ± 1.12, pectin's pH 4.26) was similar to that of *C. sinensis* (89.21 ± 1.75, pectin's pH 4.29), characterizing the pectins as being of high esterification content. Degree of esterification is a characteristic of pectin that determines its ability to form stable gels (Sundar Raj, Rubila, Jayabalan & Ranganathan, 2012). High esterification pectins (above 50%) form gels at low pH values (2.0 - 3.5) in the presence of sugar, while low esterification pectins (below 50%) enable the formation of stable gels in the presence of metal ions and absence of sugar (Joye & Luzio, 2000; Munhoz, Sanjinez-Argandona & Soares Junior, 2010). High-methoxyl pectins form gels in acidic medium with reduced water activity by the junction and stabilization of the chain network by hydrophobic interactions between methyl groups and hydrogen bonds between the protonated carboxylates and hydroxyl groups (Chan et al, 2017). The results achieved in the present work (85.74-89.21%) are higher than those reported in similar studies (70.39-79.51%) (Sotanaphun et al., 2012; Azad et al., 2014). This supports our objective of obtaining pectins with good gelling capacity for the development of a stable thickener for the management of dysphagia.

As the galacturonic acid degree relates to the quality of pectin, the results indicate that *Citrus lemon* pectin (63.41 ±7.89%) and *Citrus sinensis* pectin (56.81 ±4.26%) might behave slightly differently. Sotanaphun et al. (2012) obtained similar values, 61.62% for *C. maxima* with 4.5 pH extraction, while Chaidedgumjorn et al. (2009) achieved higher values (74.27-79.29%) for the same fruit (6.5 pH), confirming the influence of extraction methods on the presence of galacturonic acid.

The pH found (4.29 for *sinensis* and 4.26 for *lemon*) was slightly lower than that found by Sotanaphun et al. (2012), 5.72%, possibly indicating a higher degree of purity, since pectin is naturally acid.

3.3 Compound identification

ESI(–)FT-ICR mass spectra were obtained from *C. sinensis* and *C. lemon* pectin samples. The high resolution and accuracy of FT-ICR MS allowed the structural identification of 19 compounds, where their molecular formulas, *m/z* values, double bound equivalents (DBEs), and mass errors (ppm) are shown in Table 2.

Compound 1 $[C_7H_{11}O_6]^–$ ion of *m/z* 191, was identified as quinic acid in both samples, *C. sinensis* and *C. lemon* pectin. Compound 2 $[C6H9O7]^-$ ion of *m/z* 193, was identified as free galacturonic acid only in the *C sinensis* pectin sample. Compound 3 $[C_7H9O_7]$ ion of *m/z* 205, was found in both samples and identified as homocitric acid. The glucose molecule was identified as chlorine adducts, producing the compound 4 $[C_6H_{12}O_6 + Cl]^–$ ion, also in both samples. Compounds 5 and 6, $[C_{16}H_{31}O_1]^-$ and $[C_{18}H_{35}O_2]^–$ ions, were identified as fatty acids palmitic and stearic acids, respectively, in both pectin samples. Compound 7, $[C13H11O8]^-$ ion of *m/z* 295, was identified as caffeoylmalic acid. Compound 8, $[C_{13}H_{13}O_9]^-$ ion of *m/z* 313, present in both samples, was identified as norbergenin or C-glycoside of gallic acid (O-demethylated derivative of bergenin).

Compound 9, $[C13H15O9]^-$, *m/z* 315, was identified as gentisoylglucoside, which is a fluorescent marker for *C. sinensis* (Manthey, 2008). Compounds 10 and 11, $[C12H21O11]^-$ and $[C13H21O11]^-$ ions, of *m/z* 341 and m/z 353, were identified as disaccharides sucrose and methyl 6-deoxy-3-O-*β*-d-galactopyranuronosyl-*α*-l -mannopyranoside. Compounds 12, 14, 15, and 16, $[C16H27O16]^-$, $[C18H31O16]^-$, detected in both samples and identified as trisaccharide xylopyranosylcellobiose, raffinose, β-D-GlcpA-(1->3)-α- d -GalpA-(1->2)- l -rhap and -glycero- d-manno-heptopyranosyl-(1->6)-D-glucopyranosyl-(1->2)- d -glucopyranose, respectively. Compound 18, $[C24H43O22]^-$ ion of *m/z* 683, present in both samples, was identified as tetrasaccharid stachyose hydrate.

Compounds 13 and 17, $[C23H21O12]^-$ and $[C18H35O18]^-$ ions of *m/z* 489 and 539, respectively, present only in the *C. sinensis* pectin sample, were identified as a flavonoid 2"-acetylastragalin and trisaccharide melezitose dehydrate, respectively. Compound 19 present only in *C. lemon* pectin, $[C18H35O18]^-$ ion of *m/z* 787, was identified as oligosaccharide (Table 2).

Based on the chemical composition, both pectins can be classified either as xylogalacturonan or rhamnogalacturonan, with a pectin model with smooth and hairy regions (Voragen et al., 2009). The chemical data also indicated that both pectins are blended with other compounds, which could impact on the rheological quality and favor cost-benefit in an industrial scale (Canteri, Moreno, Wosiacki, & Scheer, 2012).

Table 2: Compounds identified in the pectin samples of *C. sinensis* and *C. lemon*.

Compound	**m/z (exp.)**	**Molecular Formula $[M–H]^-$**	**DBE**	**Error (ppm)**	***Sinensis***	***Lemon***	**Putative Identification**
1	191.0563	C7H11O6	2	-1.00	D	D	Quinic acid
2	193.03548	C6H9O7	2	-0.56	D	ND	Galacturonic acid

3	205.0355	$C_7H_9O_7$	3	-0.62	D	D	Homocitric acid
4	215.03304	$C_6H_{12}ClO_6$	-	-1.15	D	D	Glucose
5	255.23332	$C_{16}H_{31}O_2$	1	-1.42	D	D	Palmitic Acid
6	283.26469	$C_{18}H_{35}O_2$	1	-1.55	D	D	Stearic acid
7	295.04617	$C_{13}H_{11}O_8$	8	-0.76	D	D	Caffeoylmalic acid
8	313.05678	$C_{13}H_{13}O_9$	7	-0.86	D	D	Norbergenin
9	315.07268	$C_{13}H_{15}O_9$	6	-1.66	D	D	Gentisoylglucoside
10	341.1093	$C_{12}H_{21}O_{11}$	2	-1.07	D	D	Saccharose
11	353.10951	$C_{13}H_{21}O_{11}$	3	-1.63	D	D	Methyl 6-deoxy-3-O-β-D-galactopyranuronosyl-α-L-mannopyranoside
12	475.13105	$C_{16}H_{27}O_{16}$	3	-1.25	D	D	Xylopyranosylcellobiose
13	489.10449	$C_{23}H_{21}O_{12}$	13	-1.31	D	ND	2''-acetylastragalin
14	503.16246	$C_{18}H_{31}O_{16}$	3	-1.39	D	D	Raffinose
15	515.12614	$C_{18}H_{27}O_{17}$	5	-1.49	D	D	β-D-GlcpA-(1->3)-α-D-GalpA-(1->2)-L-Rhap

16	533.17308	C19H33O17	3	-1.41	D	D	D-glycero-D-manno-Heptopyranosyl-(1->6)-D-glucopyranosyl-(1->2)-D-glucopyranose
17	539.18369	C18H35O18	1	-1.48	D	ND	Melezitosedihydrate
18	683.22638	C24H43O22	3	1.81	D	D	Hex-2-ulofuranosyl hexopyranosyl-(1->6)hexopyranosyl-(1->6)hexopyranosidehydrate (1:1)
19	787.2352	C27H47O26	4	1.15	ND	D	6-{[6-{[6-({4,5-Dihydroxy-2-(hydroxymethyl)-6-[2,3,4-trihydroxy-1-(hydroxymethoxy)butoxy]tetrahydro-2H-pyran-3-yl}oxy)-2,4,5-trihydroxytetrahydro-2H-pyran-3-yl]oxy}-4,5-dihydroxy-2-(hydroxymethyl)tetrahydro-2H-pyran-3-yl]oxy}tetrahydro-2H-pyran-2,3,4,5-tetrol

3.4 Particle characterization and rheological analysis

The average particle size was 798.40 ± 106.25 nm for *C. lemon* pectin and 949.53 ± 144.56 nm for *C. sinensis*. Smaller structures can interact more easily with the compound of interest (Fontanive, Khalil, Cotica & Mainardes, 2014). The polydispersity index (PDI) reached 0.471 for *C. lemon* and 0.424 for *C. sinensis*, demonstrating certain uniformity in particle diameter, but also indicate broader the molecular weight. The chemical results shown in Table 2 also support the PDI obtained, as PDI is an important parameter associated with the physical stability of suspensions and low indices are desirable. A PDI between 0.1 and 0.25 indicates a narrow size distribution and values greater than 0.5 indicates a broad distribution (Patravale, Date & Kulkarni, 2004; Wu, Zhang & Watanabe, 2010).

Viscosity assumed values up to 36133 mPa.s (Figure 1), with 250 mPa.s being the viscometer's lower limit. Considering as control time 0 min and temperature 25°C, the statistical model showed that differences in viscosity between 0 min and 30 min are negligible for all the solutions tested ($p>0.05$), but viscosity increases from 0 min to 60 min and onwards ($p<0.001$) (Figure 1 and Appendix 1). The stability observed in the first 30 minutes suggests that beverages should be consumed within 30 minutes from preparation in dysphagia management.

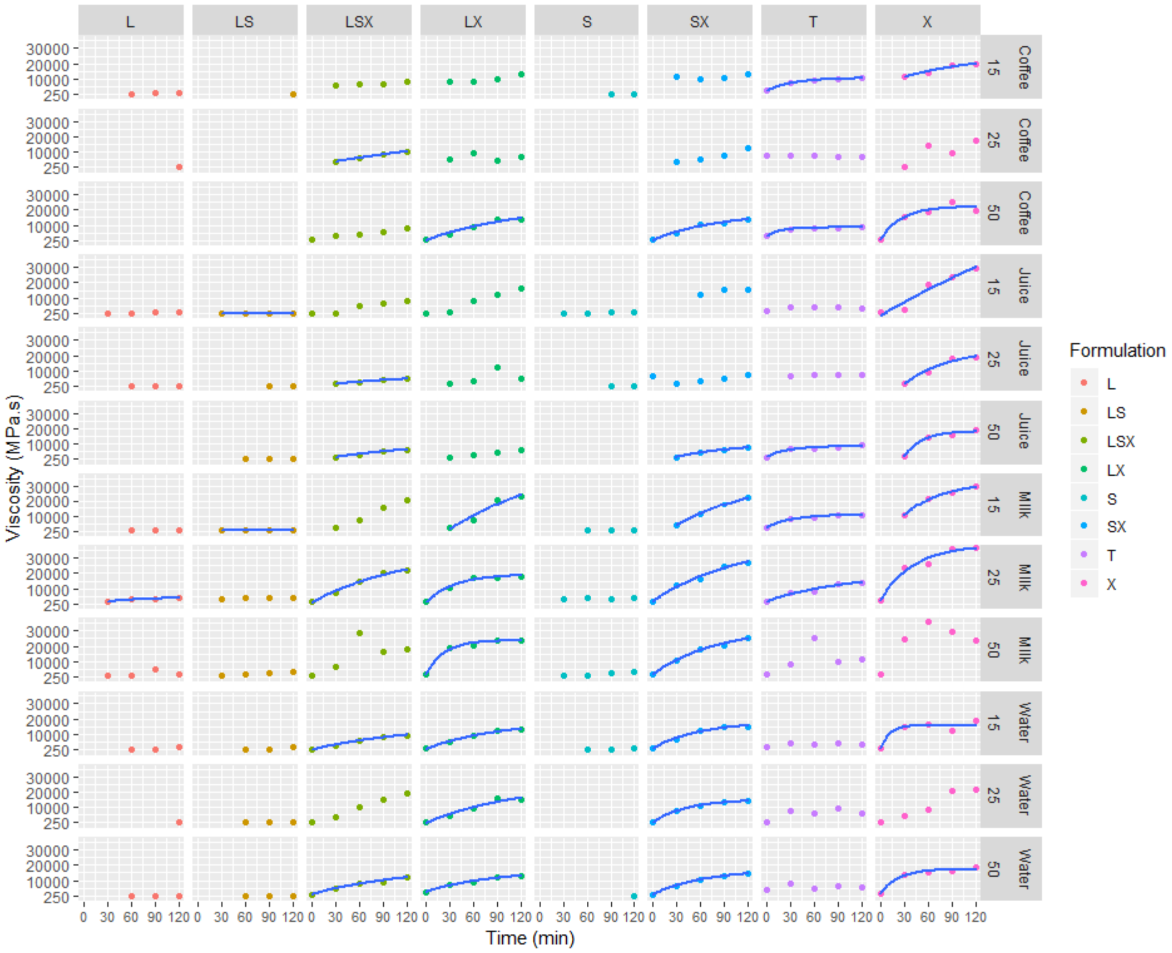

Fig. 1. Viscosity over time of different thickener formulations and fluids under different temperatures.

There was no difference between isotherms ($p>0.05$), indicating that temperature did not impact on viscosity in the value range studied (Figure 1 and Appendix 1), except for juice. In juice, higher temperatures give a lower initial viscosity (R_0) ($p<0.001$) (Appendix 1). In addition, juice was the only fluid that underwent an increase in initial viscosity by the addition of thickener agents, namely orange pectin ($p<0.001$) and control/commercial thickener ($p<0.01$) (Figure 2). In fact, orange juice has fine pulp particles and acids that can interact with the thickening agents resulting in higher viscosity (Garcia et al., 2005). All the other fluids (coffee, milk, and water) exhibited nearly the same R_0 (Figure 2) despite their different pH: instant coffee 4.8, whole milk 6.6 and mineral water 7. These results differ from previous researches that report that the base liquid impacts on the final viscosity of thickened beverages (Garin et al., 2014; Garcia, Chambers, Matta & Clark, 2005). The lower influence of the base liquids on viscosity in this work can be attributed to the high DE of the extracted pectins. The main gel formation occurs at very low pH, between 1 and 3 (Einhorn-Stoll, 2018), which does not apply to beverages commonly consumed by dysphagic patients. In the fluids tested, gelation was reduced and the pectins conveyed important stabilizing properties. Lower viscosity rates may be a positive factor concerning lower energy expenditure during processing (Venzon et al., 2015; Fracasso, Perussello, Carpine, Petkowicz & Haminiuk, 2018). It was further noted that in the formulation combining *lemon* pectin and *sinensis* pectin there was an increase in gelling potential, indicating a positive synergy between these components.

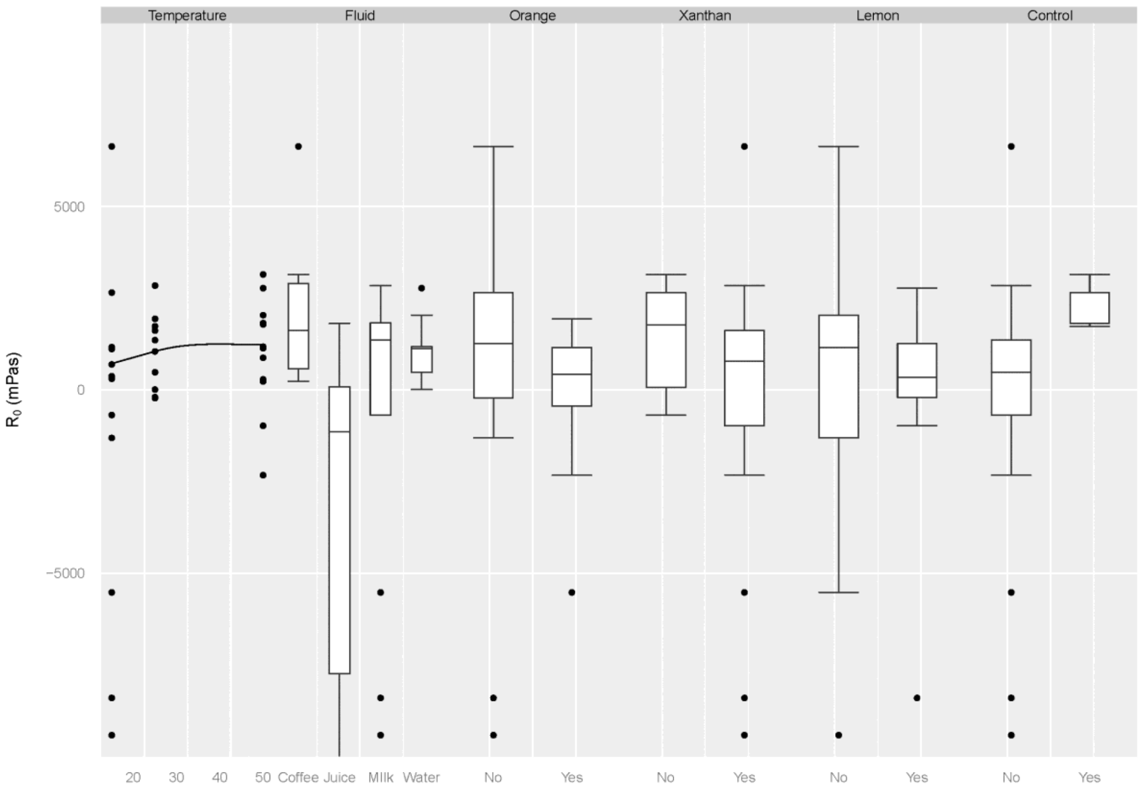

Fig. 2. Impact of fluid, thickener and temperature on viscosity model parameters: R_0.

Temperature and fluid did not influence the rate constant (lrc), but the presence of xanthan ($p<0.1$) increased lrc, (Figure 3 and Appendix 1). In practice, this means that xanthan-added formulations is less stable than the others as its viscosity change with time at a higher rate. *Lemon* pectin reduced lrc ($p<0.05$) (Figure 3 and Appendix 1) indicating lower viscosity variation, desired characteristic in products developed for dysphagia

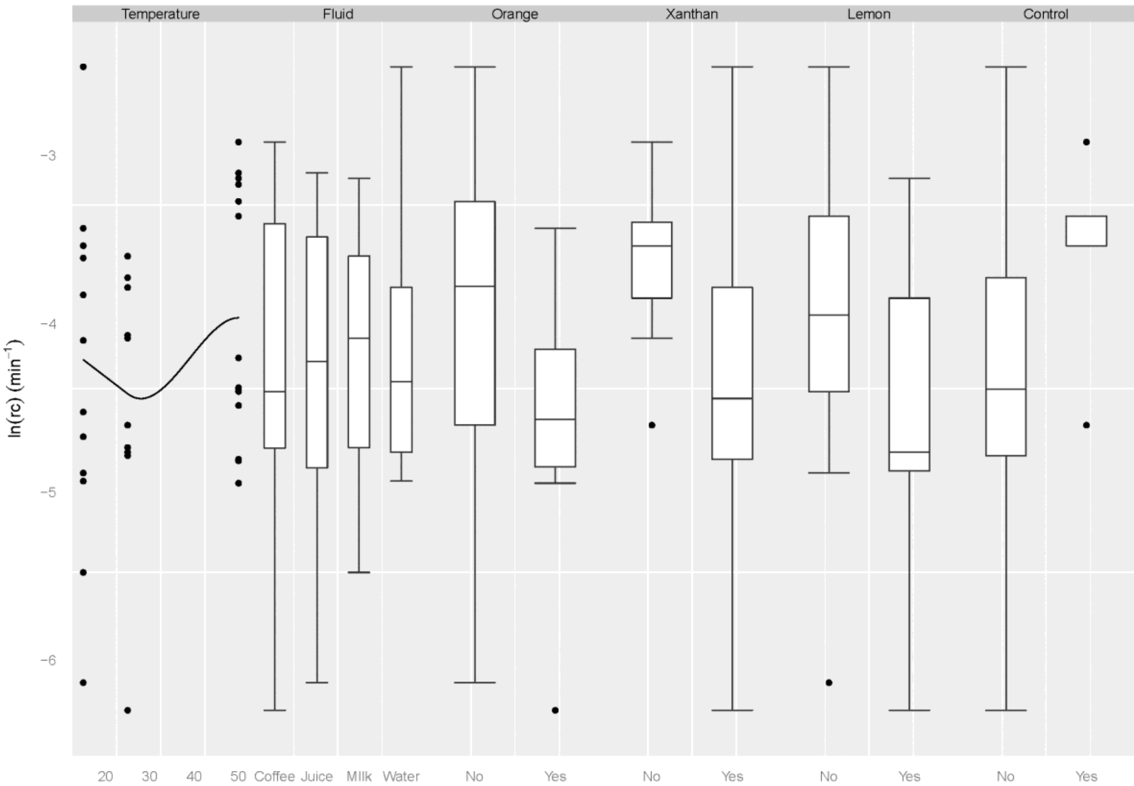

Fig. 3. Impact of fluid, thickener and temperature on viscosity model parameters: lrc.

Temperature lowers the asymptotic value (i.e., maximum viscosity) ($p<0.05$) (Appendix 2). Xanthan causes a significant increase in Asym ($p<0.05$) when present in a formulation (Figure 4 and Appendix 2). Both variables, changes in temperature and use of xanthan, promote unwanted viscosity variations in thickened beverages for dysphagic patients. Venzon et al. (2015) also investigated the association of pectins and viscosity stability and found that the viscosity decreased for all pectins when the temperature was increased. The literature also describes temperature effects on the viscosity of beverages thickened with products containing gums, where lower temperatures result in higher viscosity (Bridget, 2014; Cichero & Lam, 2014; Hadde, Nicholson & Cichero, 2015; Pagno et al., 2014; García et al., 2016; Hong, Sun, Yoo, 2012; Adeleye & Rachal, 2007). In daily life, foods are presented and thickened at different temperatures; therefore it is not possible to avoid the temperature effect. Nonetheless, the use of xanthan gum in the formulation of commercial thickeners can be avoided.

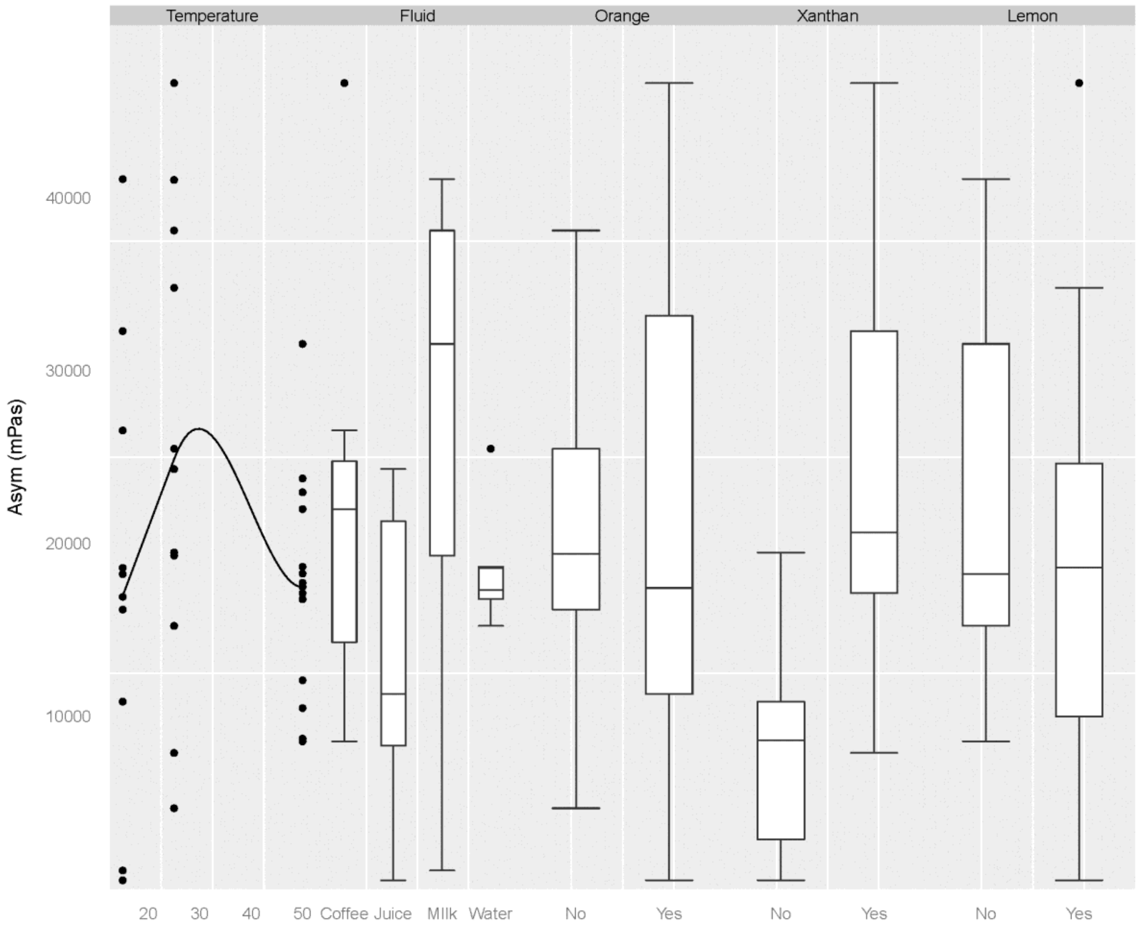

Fig. 4. Impact of fluid, thickener and temperature on viscosity model parameters: Asym.

A posthoc test was conducted to assess the effects of different pectins, xanthan gum and commercial thickener on viscosity stability (Table 3). Both *C. sinensis* and *C. lemon* pectins reduced lrc ($p<0.05$) in comparison to the control, meaning that pectin-added formulations are more stable than those added with the commercial thickener. *Lemon* pectin and orange pectin affected lrc similarly towards a more stable viscosity over time. Along with the findings from Figure 3, Appendix 1, and Appendix 2, which indicate that xanthan promotes greater final viscosities and lower viscosity stability than any other thickener, these results show that citrus pectins are viable alternatives to commercial thickeners containing xanthan gum. The new thickener formulations developed in this work are especially convenient when the thickened beverages are not consumed right after preparation.

Table 3: Effects of different pectins, xanthan and commercial thickener on the viscosity of different fluids.

lhs	rhs	estimate	std.error	statistic	p.value
R0.Xanthan - R0.Control	0	-580.887	1516.328	-0.383	0.974
lrc.Lemon - lrc.Orange	0	-0.101	0.110	-0.918	0.739
lrc.Lemon - lrc.Control	0	-2.674	1.079	-2.477	0.041
lrc.Orange - lrc.Control	0	-2.572	1.080	-2.382	0.052

The results of the present study demonstrate a beneficial effect of *sinensis* pectin and *lemon* pectin as ingredients in thickener formulations, as they slow down viscosity changes over time and allow achieving the ideal viscosity for dysphagia management products.

Conclusions

Viscosity increased over time, but was stable in the first 30 minutes for all the formulations tested, suggesting that beverages should be consumed within 30 minutes from preparation in dysphagia management. The new thickener formulations developed in this work are especially convenient when the thickened beverages are not consumed right after preparation. Changes in temperature and use of xanthan, promote unwanted viscosity variations in thickened beverages for dysphagic patients. In daily life, foods are presented and thickened at different temperatures; therefore it is not possible to avoid the temperature effect. Nonetheless, the use of xanthan gum in the formulation of commercial thickeners can be avoided.

Formulations containing at least one of the two pectins were more stable than the samples containing only xanthan or commercial thickener. These results indicate that *C. sinensis* and *C. lemon* pectins can be useful in reaching the desired stability of commercial thickeners for dysphagia management, as viable alternatives to commercial thickeners containing xanthan gum. The development of a commercial product from the *C. sinensis* and *C. lemon* pectin-based formulations constitutes the next step of this research, with a focus on improving the quality of life of dysphagic individuals.

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Supplemental data

Appendix 1 - Statistical analysis of the non-linear viscosity model: effect of temperature and time on viscosity.

```
Call:
lm(formula = Viscosity ~ Timef + Temperaturef + Timef:Temperaturef,
    data = alessandra)

Residuals:
    Min      1Q  Median      3Q     Max 
-9555.6 -4323.2  -711.7  2781.5 27555.8 

Coefficients:
                        Estimate Std. Error t value Pr(>|t|)    
(Intercept)               998.44    1190.48   0.839 0.402077    
Timef30                  3228.66    1683.59   1.918 0.055759 .  
Timef60                  5672.56    1683.59   3.369 0.000816 ***
Timef90                  7951.25    1683.59   4.723 3.08e-06 ***
Timef120                 8602.31    1683.59   5.109 4.72e-07 ***
Temperaturef15           -376.47    1683.59  -0.224 0.823159    
Temperaturef50            -36.72    1683.59  -0.022 0.982609    
Timef30:Temperaturef15   -170.97    2380.96  -0.072 0.942787    
Timef60:Temperaturef15    208.09    2380.96   0.087 0.930392    
Timef90:Temperaturef15   -149.81    2380.96  -0.063 0.949856    
Timef120:Temperaturef15   684.31    2380.96   0.287 0.773926    
Timef30:Temperaturef50    927.72    2380.96   0.390 0.696981    
Timef60:Temperaturef50   1675.88    2380.96   0.704 0.481869    
Timef90:Temperaturef50   -357.91    2380.96  -0.150 0.880577    
Timef120:Temperaturef50  -444.16    2380.96  -0.187 0.852099    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6734 on 465 degrees of freedom
Multiple R-squared:  0.189,	Adjusted R-squared:  0.1646 
F-statistic:  7.74 on 14 and 465 DF,  p-value: 8.663e-15
```

Appendix 2 - Statistical analysis of the non-linear viscosity model: effect of temperature and fluid on initial viscosity (R_0).

```
Call:
lm(formula = R0 ~ (Temperature + Fluid + Orange + Xanthan + Lemon +
    Control - 1)^2, data = v.coef)

Residuals:
   Min     1Q Median     3Q    Max
 -6557  -1480      0   1187   6557

Coefficients: (8 not defined because of singularities)
                         Estimate Std. Error t value Pr(>|t|)
Temperature                21.984    899.428   0.024  0.98090
FluidCoffee             -5396.721  22517.039  -0.240  0.81463
FluidJuice             -21239.072  17889.672  -1.187  0.25811
FluidMIlk               -6996.074  19060.110  -0.367  0.71997
FluidWater              -6809.626  21551.988  -0.316  0.75746
OrangeYes               -4106.121   7788.379  -0.527  0.60766
XanthanYes               5672.395  20683.923   0.274  0.78856
LemonNo                  9721.412   7752.025   1.254  0.23370
ControlYes              -1012.621  20662.239  -0.049  0.96172
Temperature:FluidJuice   -733.623    225.554  -3.253  0.00692 **
Temperature:FluidMIlk     248.801    199.451   1.247  0.23604
Temperature:FluidWater     43.792    193.263   0.227  0.82456
Temperature:OrangeYes     158.667    141.604   1.120  0.28443
Temperature:XanthanYes     -2.895    863.223  -0.003  0.99738
Temperature:LemonNo      -226.556    141.604  -1.600  0.13560
Temperature:ControlYes    191.887    911.968   0.210  0.83688
FluidJuice:OrangeYes    34009.077   8408.767   4.044  0.00163 **
FluidMIlk:OrangeYes      3971.708   6299.608   0.630  0.54021
FluidWater:OrangeYes     -606.219   6060.740  -0.100  0.92198
FluidJuice:XanthanYes    5918.746  13121.281   0.451  0.65997
FluidMIlk:XanthanYes    -8382.628   7783.429  -1.077  0.30266
FluidWater:XanthanYes          NA         NA      NA       NA
FluidJuice:LemonNo       8984.013   8487.400   1.059  0.31066
FluidMIlk:LemonNo       -4241.340   6299.608  -0.673  0.51353
FluidWater:LemonNo      -1052.697   6060.740  -0.174  0.86500
FluidJuice:ControlYes   42672.620  16015.313   2.664  0.02062 *
FluidMIlk:ControlYes           NA         NA      NA       NA
FluidWater:ControlYes          NA         NA      NA       NA
OrangeYes:XanthanYes           NA         NA      NA       NA
OrangeYes:LemonNo       -2167.631   4672.968  -0.464  0.65105
OrangeYes:ControlYes           NA         NA      NA       NA
XanthanYes:LemonNo             NA         NA      NA       NA
XanthanYes:ControlYes          NA         NA      NA       NA
LemonNo:ControlYes             NA         NA      NA       NA
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5051 on 12 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.8693,    Adjusted R-squared:  0.5861
F-statistic: 3.069 on 26 and 12 DF,  p-value: 0.02278
```

```
Call:
lm(formula = R0 ~ (Fluid - 1), data = v.coef)

Residuals:
   Min     1Q Median     3Q    Max
-35699   -741    461   2607   9168

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
FluidCoffee   2205.0     2793.6   0.789  0.43540
FluidJuice   -7356.7     2613.2  -2.815  0.00805 **
FluidMIlk     -699.8     2050.0  -0.341  0.73493
FluidWater    1087.7     2337.3   0.465  0.64465
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 7391 on 34 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.2071,    Adjusted R-squared:  0.1138
F-statistic:  2.22 on 4 and 34 DF,  p-value: 0.08745
```

Appendix 3 - Statistical analysis of the non-linear viscosity model: effect of temperature and fluid on the rate constant (lcr).

```
Call:
lm(formula = lrc ~ (Temperature + Fluid + Orange + Xanthan +
    Lemon + Control - 1)^2, data = v.coef)

Residuals:
    Min      1Q  Median      3Q     Max
-0.8846 -0.1548  0.0000  0.1493  0.7138

Coefficients: (8 not defined because of singularities)
                        Estimate Std. Error t value Pr(>|t|)
Temperature            -0.075112   0.107583  -0.698   0.4984
FluidCoffee            -2.567132   2.693320  -0.953   0.3593
FluidJuice             -3.017385   2.139829  -1.410   0.1839
FluidMilk              -1.911363   2.279828  -0.838   0.4182
FluidWater              0.258876   2.577888   0.100   0.9217
OrangeYes               0.456850   0.931588   0.490   0.6327
XanthanYes             -5.077547   2.474056  -2.052   0.0626 .
LemonNo                 2.058363   0.927239   2.220   0.0464 *
ControlYes             -3.015190   2.471463  -1.220   0.2459
Temperature:FluidJuice  0.004147   0.026979   0.154   0.8804
Temperature:FluidMilk  -0.011845   0.023857  -0.497   0.6285
Temperature:FluidWater -0.047834   0.023117  -2.069   0.0608 .
Temperature:OrangeYes  -0.019752   0.016938  -1.166   0.2662
Temperature:XanthanYes  0.131454   0.103252   1.273   0.2271
Temperature:LemonNo    -0.006296   0.016938  -0.372   0.7166
Temperature:ControlYes  0.090529   0.109083   0.830   0.4228
FluidJuice:OrangeYes    0.312572   1.005794   0.311   0.7613
FluidMilk:OrangeYes    -0.376869   0.753512  -0.500   0.6260
FluidWater:OrangeYes   -0.187432   0.724940  -0.259   0.8004
FluidJuice:XanthanYes   0.943294   1.569470   0.601   0.5590
FluidMilk:XanthanYes    1.564783   0.930996   1.681   0.1186
FluidWater:XanthanYes         NA         NA      NA       NA
FluidJuice:LemonNo     -0.967093   1.015199  -0.953   0.3596
FluidMilk:LemonNo      -1.146149   0.753512  -1.521   0.1541
FluidWater:LemonNo     -0.173785   0.724940  -0.240   0.8146
FluidJuice:ControlYes   0.917856   1.915632   0.479   0.6405
FluidMilk:ControlYes          NA         NA      NA       NA
FluidWater:ControlYes         NA         NA      NA       NA
OrangeYes:XanthanYes          NA         NA      NA       NA
OrangeYes:LemonNo      -0.810301   0.558945  -1.450   0.1728
OrangeYes:ControlYes          NA         NA      NA       NA
XanthanYes:LemonNo            NA         NA      NA       NA
XanthanYes:ControlYes         NA         NA      NA       NA
LemonNo:ControlYes            NA         NA      NA       NA
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6042 on 12 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.9937,	Adjusted R-squared:  0.9801
F-statistic: 73.04 on 26 and 12 DF,  p-value: 1.067e-09
```

```
Call:
lm(formula = lrc ~ Lemon + Xanthan, data = v.coef)

Residuals:
    Min      1Q  Median      3Q     Max 
-2.0087 -0.2742 -0.1009  0.3547  1.6512 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  -3.9685     0.3126 -12.695 1.17e-14 ***
LemonNo       0.5338     0.2514   2.123   0.0409 *  
XanthanYes   -0.6887     0.3045  -2.262   0.0300 *  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7643 on 35 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.2241,	Adjusted R-squared:  0.1798 
F-statistic: 5.055 on 2 and 35 DF,  p-value: 0.01178
```

```
	 Simultaneous Tests for General Linear Hypotheses

Fit: nlsLM(formula = Viscosity ~ SSasymp(Time, Asym = Asym0 + Asym1 * 
    I(Xanthan == "Yes"), R0 = R00 + R0.Xanthan * I(Xanthan == 
    "Yes") + R0.Control * I(Control == "Yes"), lrc = lrc0 + lrc.Lemon * 
    I(Lemon == "Yes") + lrc.Orange * I(Orange == "Yes") + lrc.Control * 
    I(Control == "Yes")), data = alessandra.r, start = c(Asym0 = 20340, 
    Asym1 = -1000, R00 = 2205, R0.Xanthan = 100, R0.Control = 200, 
    lrc0 = -3.96, lrc.Lemon = -0.53, lrc.Orange = -2, lrc.Control = -2), 
    control = list(maxiter = 50, tol = 1e-05, minFactor = 0.0009765625, 
        printEval = FALSE, warnOnly = FALSE), algorithm = "LM", 
    trace = FALSE)

Linear Hypotheses:
                              Estimate Std. Error z value Pr(>|z|)  
R0.Xanthan - R0.Control == 0 -580.8867  1516.3281  -0.383   0.9738  
lrc.Lemon - lrc.Orange == 0    -0.1014     0.1104  -0.918   0.7391  
lrc.Lemon - lrc.Control == 0   -2.6736     1.0794  -2.477   0.0399 *
lrc.Orange - lrc.Control == 0  -2.5723     1.0798  -2.382   0.0519 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
(Adjusted p values reported -- single-step method)
```

Appendix 4 - Statistical analysis of the non-linear viscosity model: effect of temperature and time on the upper asymptotic value (Asym).

```
Call:
lm(formula = Asym ~ (Temperature + Fluid + Orange + Xanthan +
    Lemon + Control - 1), data = v.coef)

Residuals:
   Min     1Q Median     3Q    Max
-26639 -10033  -1304   3654  85140

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
Temperature   -510.8      237.7  -2.149   0.0401 *
FluidCoffee  11865.1    16815.5   0.706   0.4861
FluidJuice   18424.8    15563.7   1.184   0.2461
FluidMIlk    15966.1    13599.1   1.174   0.2499
FluidWater    -417.7    16066.3  -0.026   0.9794
OrangeYes    -8018.3     7305.8  -1.098   0.2814
XanthanYes   36866.7    14246.0   2.588   0.0149 *
LemonNo       2903.2     7683.0   0.378   0.7083
ControlYes    9789.2    18233.7   0.537   0.5955
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 20700 on 29 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.7087,    Adjusted R-squared:  0.6182
F-statistic: 7.838 on 9 and 29 DF,  p-value: 9.272e-06

Call:
lm(formula = Asym ~ (Temperature + Xanthan), data = v.coef)

Residuals:
   Min     1Q Median     3Q    Max
-24146 -10083  -2719   4151  98988

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  20348.0     9528.2   2.136  0.03979 *
Temperature   -467.5      227.1  -2.059  0.04704 *
XanthanYes   23350.6     8466.4   2.758  0.00918 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 21020 on 35 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.228,     Adjusted R-squared:  0.1839
F-statistic: 5.169 on 2 and 35 DF,  p-value: 0.01079
```

CHAPTER 7

IMPACTS

7. IMPACTS

Speech therapists participants of the research prioritize maintenance of health and food safety for dysphagic patients, not regarding eating pleasure and individual preferences when selecting food in OD rehabilitation. This conduct could impact the patient's quality of life and also the adherence to treatment.

Professionals demonstrated reduced knowledge about the characteristics of foods most indicated for dysphagic patients, with better values in the variables texture and consistency than in the variables temperature, taste and moisture. The results indicate that the professionals are not using these characteristics properly in clinical practice or in the prescription of food, since the knowledge about the influence of texture, viscosity, temperature, taste and moisture is extremely relevant to plan a successful rehabilitation process.

Speech therapists were assertive in sorting the progression of beverages, from the thinnest to the thickest. However, results indicate reduced use of IDDSI and great diversity of terminologies used by speech therapists in the management of dysphagia. This could hinder interdisciplinary communication in hospitals, health services and also in the orientation of patients and caregivers, as well as increase risks of inappropriate use of consistency by patients, with impact on the swallowing dynamics, safety and efficiency.

Results concerning commercial thickeners evidenced differences in components, employed terminology, preparation instructions and recommended amounts. The preparation conditions and the thickened beverage may be affected by the instability of the thickeners and the lack of labels detail about time, base liquid and temperature.

Considering the development of a based-pectin product for dysphagia management, Formulations containing at least one of the two pectins were more stable than the samples containing only xanthan or commercial thickener. *Citrus sinensis* and *Citrus lemon* pectins can be useful in reaching the desired stability of commercial thickeners for dysphagia management, as viable alternatives to commercial thickeners containing xanthan gum. The development of a commercial product from the *C. sinensis* and *C. lemon* pectin-based formulations constitutes the next step of this research, with a focus on improving the quality of life of dysphagic individuals.

Concluding the present work, it is worth highlighting its intellectual, social and economic impact.

Intellectual impact relates to food characteristics and terminology, the use of commercial thickeners and the properties of pectin for a new product for dysphagia management, themes that arouse the interest of several areas, such as speech therapy, nutrition, nursing, pharmacy, food science and medicine. The knowledge approached here can be widely used and cited in the relevant literature, in addition to encouraging the development of new researches.

Considering the social impact, the work brings benefits to a wide population of dysphagic patients. The questions raised encourage professionals to deepen their knowledge and improve OD treatment, as well as the proper guidance on the use of commercial thickeners. The development of a new product for dysphagia management allows the swallowing of patients to be safer and more efficient, positively impacting their quality of life.

Finally, the work allows the exploration and emergence of new business in two different major areas, training of professionals and caregivers and development of new product. For the area of training it is suggested the creation of courses, books, websites and applications focused on speech therapy and related professions, as well as on caregivers. Such approaches may include issues related to food characteristics and their influence on the swallowing dynamics, terminologies to be used and the proper use of commercial thickeners. The development of a new product based on pectin extracted from *Citrus sinensis* and *Citrus lemon* can reach an excellent market, currently under-exploited with ineffective products. The proposed new product can be produced on a large scale at industrial level and meet the demand of dysphagic patients worldwide.

CHAPTER 8

APPENDICES

APPENDIX A

Termo de Consentimento Livre e Esclarecido

CONSISTÊNCIAS ALIMENTARES E DISFAGIA OROFARÍNGEA: O QUE DIZEM OS FONOAUDIÓLOGOS E NUTRICIONISTAS

Responsável pela pesquisa: Denise Coutinho Endringer “Universidade Vila Velha”

Este documento que você está lendo é chamado de Termo de Consentimento Livre e Esclarecido (TCLE). Ele contém explicações sobre o estudo que você está sendo convidado a participar. Antes de decidir se deseja participar (de livre e espontânea vontade) você deverá ler e compreender todo o conteúdo. Ao final, caso decida participar, você será solicitado aceitá-lo por via online e receberá uma via do mesmo por e-mail. Antes de concordar faça perguntas sobre tudo o que não tiver entendido bem.

A equipe deste estudo responderá às suas perguntas a qualquer momento (antes, durante e após o estudo). Sua participação é voluntária, o que significa que você poderá desistir a qualquer momento, retirando seu consentimento, sem que isso lhe traga nenhum prejuízo ou penalidade, bastando para isso entrar em contato com um dos pesquisadores responsáveis. A pesquisa não apresenta riscos (ou apresenta risco mínimo) à integridade física ou psicológica dos participantes. O número de registro do CRFª solicitado na pesquisa objetiva garantir a participação apenas de Fonoaudiólogos, não havendo identificação dos participantes ou do teor de suas respostas. Você pode interromper sua participação a qualquer momento apenas fechando o questionário sem enviá-lo. Esta pesquisa resultará em benefícios para os Fonoaudiólogos ao promover reflexões acerca de sua prática clínica, das características das diferentes consistências alimentares e do motivo pelo qual utiliza uma ou outra consistência e alimento. O estudo também acarretará benefícios indiretos para a comunidade científica e os pacientes com disfagia orofaríngea, em vista que os dados coletados propiciarão novas discussões a respeito da consistência alimentar segura para oferta em casos de disfagia. O questionário demora cerca de 5 minutos para ser respondido. A participação é voluntária e valorizamos muito sua contribuição. Caso tenha alguma dúvida sobre a pesquisa, mais informações podem ser obtidas por email: alessandra.machado@uvv.br. Caso você não efetive sua participação nesse momento, enviaremos um lembrete para informá-lo novamente sobre o prazo. SurveyMonkey aceitará respostas até o dia 30 de setembro de 2017. Garantimos o acesso, em qualquer etapa do estudo, sobre qualquer esclarecimento de eventuais dúvidas. Também é garantida a liberdade da retirada de consentimento a qualquer momento e assim, deixar de participar do estudo. Garantimos que as informações obtidas serão analisadas em conjunto com outras pessoas, não sendo divulgada a identificação de nenhum dos participantes. Não existirão despesas ou compensações pessoais para o participante em qualquer fase do estudo. Também não há compensação financeira relacionada à sua participação. Se existir qualquer despesa relacionada à integridade física e emocional ocasionada pela participação nesta pesquisa, ela será custeada pelos próprios pesquisadores. Comprometemo-nos a utilizar os dados coletados somente para pesquisa e os resultados serão veiculados através de artigos científicos em revistas especializadas e/ou em encontros científicos e congressos, sem nunca tornar possível a sua identificação. Todas as informações obtidas serão sigilosas. O material com as suas informações ficará guardado em local seguro sob a responsabilidade da Professora orientadora Denise Coutinho Endringer com a garantia de manutenção do sigilo e confidencialidade e de que será destruído após a pesquisa. A divulgação dos resultados será feita de forma a não identificar os voluntários. Os resultados deste trabalho poderão ser apresentados em encontros ou revistas científicas, entretanto, ele mostrará apenas os resultados obtidos como um todo, sem revelar seu nome, instituição a qual pertence ou qualquer informação que esteja relacionada com sua privacidade.

Conforme previsto pelas normas brasileiras de pesquisa com a participação de seres humanos você não receberá nenhum tipo de compensação financeira pela sua participação neste estudo. O presente estudo apresentará riscos mínimos, entretanto caso qualquer dano aconteça em decorrência da participação na pesquisa, você será recompensado por meio de garantia de atendimento na dependência da Policlínica da UVV sob o custeio financeiro das pesquisadoras. Você ficará com uma via deste Termo e toda a dúvida que você tiver a respeito desta pesquisa, poderá perguntar diretamente para Denise Coutinho Endringer, (27) 99246-3366, denise.endringer@uvv.br.

Dúvidas sobre a pesquisa envolvendo princípios éticos poderão ser questionadas ao Comitê de Ética em Pesquisa da UVV localizado na Rua Comissário José Dantas de Melo, nº 21, Boa Vista, Vila Velha-ES, CEP: 29.102-770, Tel: (27) 3421-2085, e-mail: cep.uvv@gmail.com. Horário de funcionamento: 2ª a 6ª feira – 13:30 às 18:30h. Secretária: Andréa Sarmento. Reclamações e/ou insatisfações relacionadas à participação do paciente na pesquisa poderão ser comunicadas por escrito à Secretaria do CEP/UVV, desde que os reclamantes se identifiquem, sendo que o seu nome será mantido em anonimato. CONSENTIMENTO DA PARTICIPAÇÃO DA PESSOA COMO SUJEITO Declaro que fui devidamente informado e esclarecido pelo pesquisador sobre a pesquisa CONSISTÊNCIAS ALIMENTARES E DISFAGIA OROFARÍNGEA: O QUE DIZEM OS

FONOAUDIÓLOGOS E NUTRICIONISTAS dos procedimentos nela envolvidos, assim como dos possíveis riscos e benefícios decorrentes da minha participação.

Ficou claro, também, que a minha participação é isenta de despesas e que tenho garantia do acesso aos resultados e de esclarecer minhas dúvidas a qualquer momento. Foi-me garantido que posso retirar meu consentimento a qualquer momento sem que isso me traga prejuízo ou penalidade.

____

Denise Coutinho Endringer (assinatura e CPF)

____

Participante (assinatura, nome e CPF)

APPENDIX B

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO (TCLE)

Convidamos o (a) Sr. (a) à participar, como voluntário, da pesquisa **"Consistência alimentar: as terminologias utilizadas por fonoaudiólogos no Estado do Espírito Santo".** Essa pesquisa tem como objetivo identificar as terminologias utilizadas por fonoaudiólogos, que atuem ou já atuaram em disfagia no Estado do Espírito Santo, referente às consistências alimentares, pois, acredita-se que exista diferença nas terminologias designadas a uma mesma consistência. Para esta pesquisa serão adotados os seguintes procedimentos: o (a) Sr. (a) responderá a um questionário de informações gerais e em segundo momento, deverá ordenar os alimentos, que serão apresentados em recipientes de cores variadas, fazendo uma progressão do mais ralo para o mais espesso e deverão marcar os círculos que constam na folha de respostas com canetas hidrocor, observando a cor do recipiente e a ordem de progressão realizada. Em seguida deverá nomear cada consistência escrevendo a terminologia que utiliza. A presente pesquisa oferece riscos mínimos à integridade física do participante. Demandará tempo pela participação (cerca de 20 minutos) e o risco de sentir-se constrangido no caso de dúvidas. A pesquisa trará benefícios diretos aos participantes, ao receberem orientações sobre terminologias de diferentes consistências, e indiretos acadêmicos e científicos para as Ciências Fonoaudiológicas. Para participação neste estudo, o (a) Sr. (a) não terá nenhum custo financeiro, bem como, não receberá nenhuma remuneração pela mesma.

Este termo de consentimento encontra-se impresso em duas vias originais, sendo que uma será arquivada pelo pesquisador responsável, e a outra será fornecida ao Sr. (a). Os dados e instrumentos utilizados na pesquisa ficarão arquivados com o pesquisador responsável por um período de 5 (cinco) anos, e após esse tempo serão destruídos. As pesquisadoras tratarão a sua identidade com padrões profissionais de sigilo, atendendo a legislação brasileira (Resolução Nº 466/12 do Conselho Nacional de Saúde), utilizando as informações somente para os fins acadêmicos e científicos.

Eu, ____, portador (a) do documento de identidade ___________________ declaro que fui informado (a) dos objetivos da pesquisa **"Consistência Alimentar: as terminologias utilizadas por fonoaudiólogos no Estado do Espírito Santo"** de maneira clara e detalhada e esclareci minhas dúvidas. Sei que a qualquer momento poderei solicitar novas informações e modificar minha decisão de participar se assim o desejar.

Declaro que concordo em participar. Recebi uma via original deste termo de consentimento livre e esclarecido e me foi dada a oportunidade de ler e esclarecer as minhas dúvidas.

Vila Velha, _________ de __________________________ de 2018.

____

Assinatura do Participante

____

Assinatura da Pesquisadora Responsável

____

Assinatura da Pesquisadora Assistente

____

Assinatura da Pesquisadora Assistente

Pesquisadora Responsável: Alessandra Salles Machado

Endereço: Avenida Comissário José Dantas de Melo 21, Boa Vista, Vila Velha-ES

CEP: 29102-920

Fone: (27) 3421-2001

E-mail: alessandra.machado@uvv.br

Pesquisadoras Assistentes:

Cyntia Hellene dos Santos Moreira **Email:** cyntiahellene@hotmail.com

Deuzi Caetano da Silva Vimercati **Email:** deceju@yahoo.com.br

CHAPTER 9

ANNEXES

ANNEX A

Pesquisador: Denise Coutinho Endringer

Título da Pesquisa: CONSISTÊNCIAS ALIMENTARES E DISFAGIA OROFARÍNGEA: O QUE DIZEM OS
FONOAUDIÓLOGOS

Instituição Proponente: SOC EDUC DO ESP SANTO UNIDADE DE V VELHA ENSINO SUPERIO

Versão: 1

CAAE: 56273316.0.0000.5064
Área Temática:

DADOS DO PROJETO DE PESQUISA
Número do Parecer: 1.592.312

DADOS DO PARECER
Apresentação do Projeto:
A deglutição é um processo natural que visa transportar o alimento da cavidade oral para o estômago, nãopermitindo a entrada de substâncias na via aérea. A disfagia é definida pelo Conselho Federal de Fonoaudiologia como "um distúrbio de deglutição com sinais e sintomas específicos, caracterizado por alterações em qualquer fase ou entre as fases da dinâmica da deglutição, de origem congênita ou adquirida, podendo gerar
prejuízo pulmonar, nutricional e social". Um dos objetivos do tratamento fonoaudiológico com pacientes disfágicos é restabelecer a dieta por via oral e para tal o fonoaudiólogo deve selecionar a consistência da dieta assim como sua progressão a fim de garantir a redução do risco de aspiração traqueal. A consistência pastosa na maioria dos casos pode ser a mais segura por ser de fácil controle na cavidade oral, não exigir a fase preparatória da deglutição e apresentar maior duração do trânsito faríngeo. Entretanto, não há consenso sobre que consistência realmente pode ser considerada segura para ser ofertada ao paciente disfágico nem tampouco sobre que características são desejadas em determinado alimento para que traga segurança ao processo de deglutição. Estudos sobre diferentes consistências,
características alimentares, deglutição e disfagia
Patrocinador Principal: Financiamento Próprio
Riscos:
A pesquisa apresenta risco mínimo à integridade física ou psicológica dos participantes, uma vez que os mesmos responderão a um questionário eletrônico acerca de consistências alimentares e tem-se como risco mínimo (considerando o tempo de 5 minutos) de cansaço pelo uso de tela de computador ou digitação. O Fonoaudiólogo pode interromper sua participação a qualquer momento apenas fechando o questionário sem enviá-lo, o que minimiza a possibilidade de risco ou desconforto.
Benefícios:
Esta pesquisa resultará em benefícios para os Fonoaudiólogos ao promover reflexões acerca de sua prática clinica, das características das diferentes consistências alimentares e do motivo pelo qual utilizam uma ou outra consistência e alimento. O estudo também acarretará benefícios indiretos para a comunidade científica e os pacientes disfágicos em vista que os dados coletados propiciarão novas discussões a respeito da consistência alimentar segura para oferta em casos de disfagia orofaríngea.
Situação do Parecer: Aprovado
Necessita Apreciação da CONEP: Não

VILA VELHA, 15 de Junho de 2016
Zilma Maria Almeida Cruz
(Coordenador)

ANNEX B

UNIVERSIDADE VILA VELHA -ES/UVV

DADOS DO PROJETO DE PESQUISA
“Consistência alimentar: as terminologias utilizadas por fonoaudiólogos no Estado do Espírito Santo”.
Número do Parecer: 2.490.627

DADOS DO PARECER
Patrocinador Principal: Financiamento Próprio

Apresentação do Projeto:
A deglutição é um ato complexo que depende da integridade do sistema neuromuscular e tem como objetivo levar o alimento para o tubo digestório sem que ocorra penetração ou aspiração em vias aéreas inferiores, (JACOBI; LEVY; SILVA, 2004).Segundo Jotz, Carrara-de Angelis e Barros (2009), a disfagia é definida como qualquer dificuldade em alimentar-se por via oral. De acordo com Portas e Guedes (2014), as limitações da alimentação, quando envolvem dificuldade na efetividade e na segurança da deglutição, podem acarretar consequências graves para a qualidade de vida dos pacientes.Segundo Mourão (2014), a determinação da via oral segura sem riscos pulmonares para manutenção do estado nutricional, é o principal norteador da reabilitação fonoaudiológica em disfagia.A atuação fonoaudiológica inclui diagnóstico e tratamento. No tratamento ofonoaudiólogo intervém, dentre outros, na modificação das consistências alimentares, espessando líquidos etriturando sólidos (JOTZ; CARRARA DE ANGELIS; BARROS, 2009). No tratamento fonoaudiológico, objetiva-se para o paciente disfágico uma deglutição segura e eficaz que o possibilite alimentar-se por via oral, levando em consideração aspectos que o paciente considere de maior importância para sua qualidade de vida (JOTZ; CARRARA-DE ANGELIS; BARROS, 2009).Atualmente, não existe no Brasil uma terminologia unificada para se referir às consistências alimentares, mas, entende-se que seja fundamental a padronização de uma nomenclatura, (SORDI; MOURÃO; SILVA, 2012). Internacionalmente são utilizadas diversas terminologias padronizadas, com destaque para National Dysphagia Diet (NDD) e International Dysphagia Diet Standardisation Initiative (IDDSI). A NDD foi publicada em 2002 pela American Dietetic Association com intuito de estabelecer uma terminologia padrão e aplicações práticas de modificação da textura dietética na disfagia. Ela estabelece quatro níveis para alimentos líquidos, sendo eles: ralo,néctar, mel e pudim (ASHA, 2003). A IDDSI foi fundada em 2013 com o objetivo de desenvolver uma terminologia e definições padronizadas à nível global para descrever as consistências alimentares utilizadas para indivíduos com disfagia. Ela apresenta 8(oito) níveis de consistência, sendo eles do nível 0 (zero) ao nível 7 (sete), seguindo a ordem do mais ralo ao mais espesso e apresenta as formas de medições das consistências, utilizando seringas, garfos e colheres (IDDSI, 2016).A modificação da textura dos alimentos facilita a alimentação do disfágico. Controlando a consistência dos alimentos evitam-se os riscos de aspiração e agravamento do paciente, sendo assim, a falta de padronização da nomenclatura das consistências gera riscos ao processo de reabilitação do paciente e incertezas entre os profissionais, (PAGNO et al, 2014).Nesse sentido o presente trabalho justifica-se na necessidade de padronização de uma nomenclatura nacional, para designar as consistências alimentares no tratamento de pacientes disfágicos, com intuito de obter

concordância entre os profissionais que atuam em disfagia, objetivando segurança e eficácia na reabilitação do paciente.
Objetivo Primário:
Identificar as terminologias utilizadas por fonoaudiólogos que atuem ou já atuaram em disfagia, no Estado do Espírito Santo, referentes às consistências alimentares líquidas e pastosas.
Objetivo Secundário:
Objetivo da Pesquisa:
Identificar as nomenclaturas utilizadas por fonoaudiólogos, que atuem ou já atuaram em disfagia, no Estado do Espírito Santo, para consistências alimentares líquidas.Identificar as nomenclaturas utilizadas por fonoaudiólogos, que atuem ou já atuaram em disfagia, no Estado do Espírito Santo, para consistências alimentares pastosas. Averiguar se há concordância entre as nomenclaturas das consistências alimentares utilizadas por fonoaudiólogos, que atuem ou já atuaram em disfagia, no Estado do Espírito Santo.
Identificar se os fonoaudiólogos, que atuem ou já atuaram em disfagia, no Estado do Espírito Santo, utilizam a nova nomenclatura conforme a IDDSI, para as consistências alimentares líquidas e pastosas.
Riscos: A presente pesquisa apresenta risco mínimo à integridade física do participante, uma vez que os produtos não serão consumidos. A pesquisa demandará tempo dos fonoaudiólogos para participação. Poderão sentir-se constrangidos no caso dedúvida e cansados durante a participação na pesquisa.
Benefícios: A pesquisa trará benefícios indiretos acadêmicos e científicos para as Ciências Fonoaudiológicas. Os participantes receberão a cartilha IDDSI.

Avaliação dos Riscos e Benefícios:
A pesquisa é relevante. A mesma poderá contribuir com o ensino, a pesquisa e a extensão da UVV.
Comentários e Considerações sobre a Pesquisa:
A pesquisa apresenta todos os termos de apresentação obrigatória.

Considerações sobre os Termos de apresentação obrigatória:
O projeto de pesquisa atende os critérios do comitê de ética e o mesmo irá contribuir com a temática.

Conclusões ou Pendências e Lista de Inadequações: O Colegiado acata o parecer do relator.
Considerações Finais a critério do CEP:
Este parecer foi elaborado baseado nos documentos abaixo relacionados:
Tipo Documento Arquivo
Postagem Autor
Situação Informações Básicas do Projeto
Situação do Parecer: Aprovado
Necessita Apreciação da CONEP: Não
VILA VELHA, 07 de Fevereiro de 2018
Zilma Maria Almeida Cruz
(Coordenador)