ASM Sc. J., 18, 2023

https://doi.org/10.32802/asmscj.2023.1236

A Sensory Study on the Effect of Different Thickeners in Texture-Modified Chicken *Rendang*

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A sensory study was conducted to evaluate the acceptability of texture modified chicken rendang (TMCR) added with different thickeners (modified corn starch (MC), sago starch (S), tapioca starch (T), xanthan gum (XG) and carboxymethyl cellulose gum (CMC) among healthy elderly consumer. The sensory evaluation was rated using the hedonic test with visual 7-points Cued Facial Scale (CuFS) for ease of swallowing, overall appearance, and overall texture's attributes. Meanwhile, a categorical scale ('Yes' or 'No' answer) was used to evaluate purchase intention, liking on the flavour, residues left after swallowing, and sample's aftertaste. Results showed that all samples were highly accepted for all attributes tested. The insignificant difference between all samples using Cued Facial Scale could be due to similar physical appearance as well as reduced sensory capability among the elderly panellists. Besides, all thickened samples were found to be free from any food residues after swallowing, due to higher cohesion between food particles contributed by the thickeners. In addition, the use of thickeners shown to prevent easy disintegration of food particles during oral consumption which involved tongue and palate shear in the presence of saliva. Even though 79% of the panellists in perceived a starchy taste for all thickened samples, this attribute did not affect the purchase intention and flavour acceptance of the developed products, as both received more than 79% and 85 % likings, respectively. The finding shows that the elderly panellists had a good impression on the developed TMCR, which indicates its promising prospect for product commercialisation.

Keywords: Sensory study; texture-modified chicken rendang; elderly; thickeners

I. INTRODUCTION

The number of ageing population worldwide is increasing, attributed to the decrease of fertility rate as well as the significant increase in life expectancy. Elderly population which refers to those 65 years old and above is expected to increase with increasing longevity and better healthcare system (Orimo *et. al.,* 2006; United Nations, 2020). However, due to advancing age, elderly experienced reductions in the muscle mass, loss their dentition, reduced muscle strength and suffers fatigue from chewing. Some elderly may also suffer from dysphagia; a medical term used to indicate swallowing difficulties. Dysphagia may result in more serious complications such as aspiration, choking, and even mortality. Hence, the elderly naturally select 'soft' foods that are easier to chew and swallow. To increase both food acceptability and food intake among elderly, it is very crucial to provide elderly with familiar food that is easy to chew and swallow. Steenvoorden (2018) reported that a flavourful traditional dish would help to compensate for the loss of chemosensory among elderly and increase their eating pleasure.

In Malaysia, *rendang* is a famous meat-based traditional dish that is very aromatic and flavourful. Its popularity is not only confined within Malaysia but expanded across the Southeast Asian region and the western countries ("South-east Asian", 2018). Interestingly, in 2011, *rendang* has been regarded as the world's most delicious food by CNN online

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voters (Cheung, 2011). Therefore, chicken *rendang* fulfil the criteria to be chosen as the traditional food for textural modification, aiming to help elderly to chew and swallow efficiently.

An addition of starch or gum as food thickener during textural modification are common practice. Modified corn starch has long been used as food thickener in dysphagia diet (Garcia & Chambers, 2019; Ilhamto, 2012; Payne *et al.,* 2012). This thickener able to thicken food without heating process, with acceptable rheological and sensory properties. According to Nishinari *et al.* (2013), the addition of modified corn starch into texture-modified food (TMF) causes the internal food's structure to have a coherent property, preventing fractional breakup during swallowing.

Apart from starches, gums are also popular as food thickener. Generally, gums are more viscous and require less amount to provide similar viscosity to starches (Saha & Bhattacharya, 2010). Gums have higher shear thinning property, providing greater extensibility thus allowing easier swallowing. Gums are also resistant towards enzymatic digestion, providing rheological stability by preventing disintegration of food particles that can lead to aspiration (Nishinari *et. al.,* 2019; Leonard *et al.,* 2014). In processed meat, gums are used as a fat replacer that provides a lubricant mouth feel like the sensory perception of fat (McArdle, Hamill, & Kerry, 2011).

Among gums, xanthan and carboxymethyl cellulose (CMC) have been formerly used in dysphagia diet (Sharma *et al.,* 2017). Effects of both xanthan gum and carboxymethyl cellulose gum addition into foods and drinks has been conducted previously (Lopez *et. al.,* 2018; Ong, 2017; Sharma *et. al.,* 2017; Tashiro *et al.,* 2010). Rheologically, both gums are quite similar except for their shear thinning behaviour in which xanthan gum was found to be higher than carboxymethyl cellulose gum (Lopez *et. al.,* 2018; Tashiro *et al.,* 2010). The high shear thinning behaviour of xanthan gum was further confirmed through sensory analysis based on the feeling of slippery and easier oral manipulation (Ong Steele, & Duizer, 2018). In addition, the use of xanthan gum resulted in a smooth, sticky, and slimy appearance with mouth coating effects. In a separate study, CMC was perceived to be greasy or oily attributed to the low degree of shear thinning (Lopez *et al.,* 2018).

Even though it is common to use modified corn starch, xanthan gum and carboxymethyl cellulose gum for textural modification, the search for a cheaper alternative and locally available source such as sago and tapioca starch remain active (Karim *et. al.,* 2008; Pongsawatmanit, Temsiripong, & Suwonsichon, 2007). The use of sago and tapioca starch have shown to improve physical and sensory properties of ground meat products (beef and chicken patties) and fish crackers (keropok lekor) (Chatterjee *et. al.,* 2018; Nur Liyana, NorKhaizura & Ismail-Fitry, 2019). However, addition of starch is reported to produce starchy taste, coarser texture, and high flavour intensity (Ong *et. al.,* 2018; Sharma & Duizer, 2019; Vickers *et al.,* 2015).

In general, addition of different thickeners has been reported to affect the perception of flavour, taste, texture, as well as the condition of the food matrices during oral processing (Arancibia *et al.,* 2015). As different thickeners can impart different sensory perception, therefore it is important to determine consumer's acceptability on the developed product. High acceptability often leads to the success of the food product upon commercialisation (Agyekum *et. al.,* 2015; Simeone & Marotta, 2010, Valentova & Panovska, 2003).

During sensory evaluation among elderly panelist, a special consideration needs to be taken into account, as their reduced physical and cognitive functions might affect the sensory evaluation process. The use of suitable assessing sensory scales such as the Cued Facial Scale (CuFS) and the categorical scale can certainly ease them during the assessment. The CuFS consists of a set of smiley faces whereas the categorical scale uses the 'Yes' and 'No' nominal variables. Both scales were used to help them in differentiating the rating and giving response by just pointing at the scores or answer during the study (Steenvoorden, 2018).

In this present study, the sensory acceptability of texture modified chicken rendang (TMCR) incorporated with different thickeners (sago starch, tapioca starch, modified corn starch, xanthan gum, and carboxymethyl cellulose gum) among healthy elderly consumer were evaluated.

II. MATERIALS AND METHOD

This sensory study was conducted following approval from the USM Research Ethics Committee (Ethics no: USM/JEPeM/ 17090385).

A. Preparation of Texture-Modified Chicken Rendang (TMCR)

All ingredients were purchased from a supermarket in Kepala Batas, Penang. Chicken breast meat (30g) was ground for 5 min using a bowl cutter mixer R5 (Robot Coupe, France). The ground chicken meat was heated using a slow fire together with rendang paste (brand Mak Nyonya, Johor) using cooking stove for 3 min. The heating was continued further for 4 min with the addition of 200mL UHT coconut cream extract and filtered water. The cooked chicken rendang was then left to cool at room temperature (30 min) prior to processing into a puree texture using a food processor (Model MK-5087M, Panasonic, Osaka) for 30 s. The puree was then added with thickener (in the form of gelatinised starch and gum solution).

The thickeners used are gelatinised modified corn starch (MC) using commercial thickener (brand Valens Thixer), sago and tapioca starch gel, solutions of carboxymethyl cellulose gum (CMC) and xanthan gum (XG). All thickeners were individually added into the TMCR at 30 g addition and the processing was continued for another 30 s.

The texture of samples after the addition of thickeners was prepared to comply with Texture C (fine puree with lump free) as outline by Australian dysphagia standard (Dietitians Association of Australia and The Speech Pathology Association of Australia Limited 2007). The gelatinised starch was prepared by heating the starch powder in filtered water with a concentration of 10% whereas xanthan gum solution was prepared by dispersing it in filtered water at a concentration of 5%. Meanwhile, TMCR without any addition of thickener was used as the control (C) sample.

All samples were cooked and prepared before the sensory day, in which all samples were cooked, blend, sieved using kitchen sieve to obtain homogeneous texture, before being kept at -20 °C. Twenty-four hours before sensory evaluation, samples were thawed at refrigeration temperature (4 °C). On the sensory day, samples were heated in a microwave oven until its core temperature reached 75 °C (to prevent infections from potentially harmful bacteria such as *Salmonella* and *Campylobacter*) before being cooled down to room temperature (Centers for Disease Control and Prevention, 2022). The samples were spooned (1 tablespoon ~ 20 g) into small plastic cups coded with 3-digit numbers. Each sample were served one after another. The coded samples were presented in a randomised order.

B. Study Location

An elderly home namely Darul Hanan Pulau Pinang, situated at Kepala Batas, Penang was chosen as the study location.

C. Sample Size Calculation

According to O'Sullivan (2016), during product development and optimisation processes, sensory acceptance testing requires between 25 - 75 participants. Using simple proportion formula, $(z/\Delta)2\ p\ (1-p)$ (Negida, 2018) with anticipated population proportion, $p= 0.03228$ $z = 1.96$, precision, $\Delta = 0.05$, the sample size (n) is 48 (Laureati *et al.,* 2006). Considering 20% dropout rate, a total of 58 participants from the elderly home are required in this study. Laureati *et al.* (2006) was selected as a reference for the sample size calculation since the subject of the study were similar (elderly) and the selected food samples were the familiar dishes to the elderly (Mediterranean dishes).

D. Recruitment and Screening of Participants

The recruitment of participants was conducted by the Management of the elderly home (Darul Hanan Pulau Pinang). The screening was made based on the inclusion and exclusion criteria. Details are as stated as follows:

1. Inclusion criteria

Participants who are physically healthy, aged more than 60 years old and without any cognitive deficit were included in this study. Those who have medical problems which under controlled medications, such as hypertension and diabetes, were also be included. Apart from that, individuals who are edentulous and those who wear false teeth were allowed to participate.

2. Exclusion criteria

Elderly who has illnesses on the day of the study (e.g., sore throat, fever, flu, diarrhoea) were excluded from participating in the study.

Figure 1. The modified seven points scale of the CuFS used during the sensory study (Pelletier & Lawless, 2003).

E. Sensory Evaluation

Prior to start the sensory session, participants were interviewed for screening purposes, based on the inclusion and exclusion criteria (Section C1 and C2). The participants were asked to seat at a designated table before briefing session was conducted, to explain how the sensory session will be conducted and the risk of the sensory evaluation. Participants were asked to read and signed the inform consent form before the sensory session starts.

The sensory session was conducted in a small group, consist of 10 participants in one group. One mentor was assigned for each group. The appointed mentors were among the postgraduate students from the School of Industrial Technology, Universiti Sains Malaysia (USM). The mentors were trained a day before the sensory session by the principal investigator. The participants were reminded not to talk to each other during the session to avoid any discussion on the results.

Prior to tasting, participants were asked to observe and smell the sample before eating and then give evaluations based on the questions asked. Any unfinished samples were discarded. Each participant spent approximately 2 h to finish answering all the questions. The sensory evaluation was rated using the hedonic test with visual 7-points Cued Facial Scale (CuFS) (Figure 1), whereby '1' indicates dislike extremely and '7' indicates like extremely. The acceptable limit with respect to the sensory evaluation score was set at 5.0 and scores of lower than 4.0 was considered as unacceptable. The CuFs was used to assess participant's perception on the ease of swallowing, the overall appearance, and the overall texture of the sample. For the categorical 'Yes' or 'No' part, the questions include purchase intention, taste, residues left after swallowing, and sample's aftertaste. Total of 6 samples were presented to the participants at an interval of 10 min to give participants enough time to evaluate the sample. After evaluating each sample, they were asked to cleanse their mouth with filtered water before proceeding to the next sample.

F. Incentives

Every participant was given a goodie bag worth RM20 upon completion of the sensory evaluation.

G. Data Analysis

Data are shown in mean and $\pm$ SD and was later analysed using SPSS version 22. Numerical data was analysed using analysis of variance (ANOVA) and followed by Tukey post-hoc test (when there is significant difference when $p < 0.05$). Categorical data (Yes or No answer) was presented as frequency (percentage) of rating on each sample.

III. RESULTS AND DISCUSSION

Out of the total 58 participants who initially joined, only 49 managed to complete the study. The completed participants consist of 47 females and 12 males, aged between 60 to 83 years. All participants are Malay, except for 1 Chinese participant. Meanwhile, the sensory attributes were divided based on Cued facial scale and the categorical scale.

A. Ease of Swallowing, Overall Liking, And Overall Texture (Cued facial scale)

In general, all evaluated samples were acceptable with score > 5.0 rated by the participants, in terms of ease of swallowing, overall appearance and overall texture (Table 1). Statistically, all samples were found to be insignificantly different ($p > 0.05$) in all three attributes.

Based on the scales given by the participants, the three main attributes receive high likings from the panellist. The insignificant difference between samples revealed that the types of thickeners did not affect the three sensory attributes due to physical similarities among samples (Figure 2). This could be due to similar methods and ingredients used for the preparation of TMCR, except for the thickeners.

Besides, the reduced in sensory acuity (vision, touch, hearing, taste, and smell), as well as cognitive ability (decision making, processing information, memorisation) among the elderly, could also contribute to such results. Both sensory decline and cognitive decline in elderly are caused by neurobiological changes, such as detrimental vascular changes and accumulation of neuropathology (Statsenko *et al.,* 2021). Due to these neurobiological changes, there is a high probability of the participants having processing deficits in various senses (vision, touch, hearing, taste, and smell) and cognitive deficits (Humes & Young, 2016). These conditions may cause the participants to be not fully conscious of the sample's attributes, therefore incapable to provide relevant information related to the questions.

Kremer *et al.* (2007) revealed that elderly participants need a higher flavour intensity and thickener concentration to experience the same difference compared to younger participants during the assessment for intensity and liking ratings of custard dessert. In the same study, elderly participants were observed to have a reduced sensitivity to taste, olfactory, trigeminal stimuli and reduced chewing efficiency.

Table 1. Sensory acceptability of TMCR added with different types of thickeners mean score (n=49)

Samples	Attributes		
	Ease of swallowing	**Overall appearance**	**Overall texture**
TMCR Control (C)	5.82 ± 1.33^{a}	5.71 ± 1.14^{b}	5.73 ± 1.55^{c}
TMCR with Sago starch (S)	5.96 ± 1.31^{a}	6.14 ± 0.98^{b}	5.73 ± 1.37^{c}
TMCR with Tapioca starch (T)	6.10 ± 1.08^{a}	6.24 ± 0.90^{b}	5.92 ± 1.35^{c}
TMCR with Modified corn starch (MC)	6.12 ± 1.18^{a}	6.02 ± 1.16^{b}	5.94 ± 1.43^{c}
TMCR with Xanthan gum (XG)	6.22 ± 1.03^{a}	6.06 ± 1.05^{b}	5.92 ± 1.26^{c}
TMCR with Carboxymethyl cellulose gum (CMC)	6.27 ± 1.25^{a}	6.29 ± 1.12^{b}	5.98 ± 1.39^{c}

Note: Values expressed as mean score ± standard deviation. Score with different superscript ($^{a-c}$) letter in the same column are significant difference at ($p < 0.05$).
Score 1 refers to Dislike Extremely while Score 7 refers to Like Extremely.

On another note, Lopez *et al.* (2018) stated that even healthy participants with normal swallowing ability also lacks in sensitivity towards differentiating the ease of swallowing attribute. The ease of swallowing attribute is regarded as being able to swallow effortlessly (less effort needed to move the bolus from the oral cavity into the pharynx), while at the same time, it flows as one coherent bolus through the pharynx with consistent flow velocity (Funami, 2011). Such behaviour is said to be directly proportional to the feeling of slimy in the mouth which is often regarded as unacceptable (Szczesniak, 2002; Vickers *et al.,* 2015).

The insensitivity of the healthy panellist in evaluating the ease of swallowing has been studied by Nystrom *et al.* (2015) using three different types of fluids. The fluids are categorised as (i) Shear thinning; viscosity reduce when shear rate increase, (ii) Boger; an elastic fluid with constant viscosity, and (iii) Newtonian; viscosity is independent of shear rate. The authors found out that only dysphagic individuals were able to distinguish ease of swallowing between the three fluid categories. The healthy individuals, on the other hand, evaluated better on attributes that are related to mouth feel (thickness, stickiness, slippery, melting, elastic, and sticky after feeling). The overall appearance refers to visual perspective on the palatability of the food samples as it can trigger meal initiation. Meanwhile, texture is another determinant for food acceptability. The overall texture in this study refers to the liking of consistency and graininess. Hall and Wendin (2008) reported that, firm consistency is needed for an easy swallowing attribute.

Meanwhile, the feeling of graininess is inherent in meat-based puree due to the presence of fine particles, which lead to higher food intake (Maina, 2018; McCrickerd & Forde, 2016). The high likings indicate that the pureed samples still entice the participants. It could be due to the influence of the familiar *rendang* flavour on the ratings of the overall food's appearance. Previous research showed that food intake

among the elderly is usually similar to what they have in their past life (Wendin *et. al.*, 2010; Edfors & Westergren 2012). Based on the likings of texture attribute, it shows that the participants accepted the consistency of all samples and seems did not mind on the feeling of graininess.

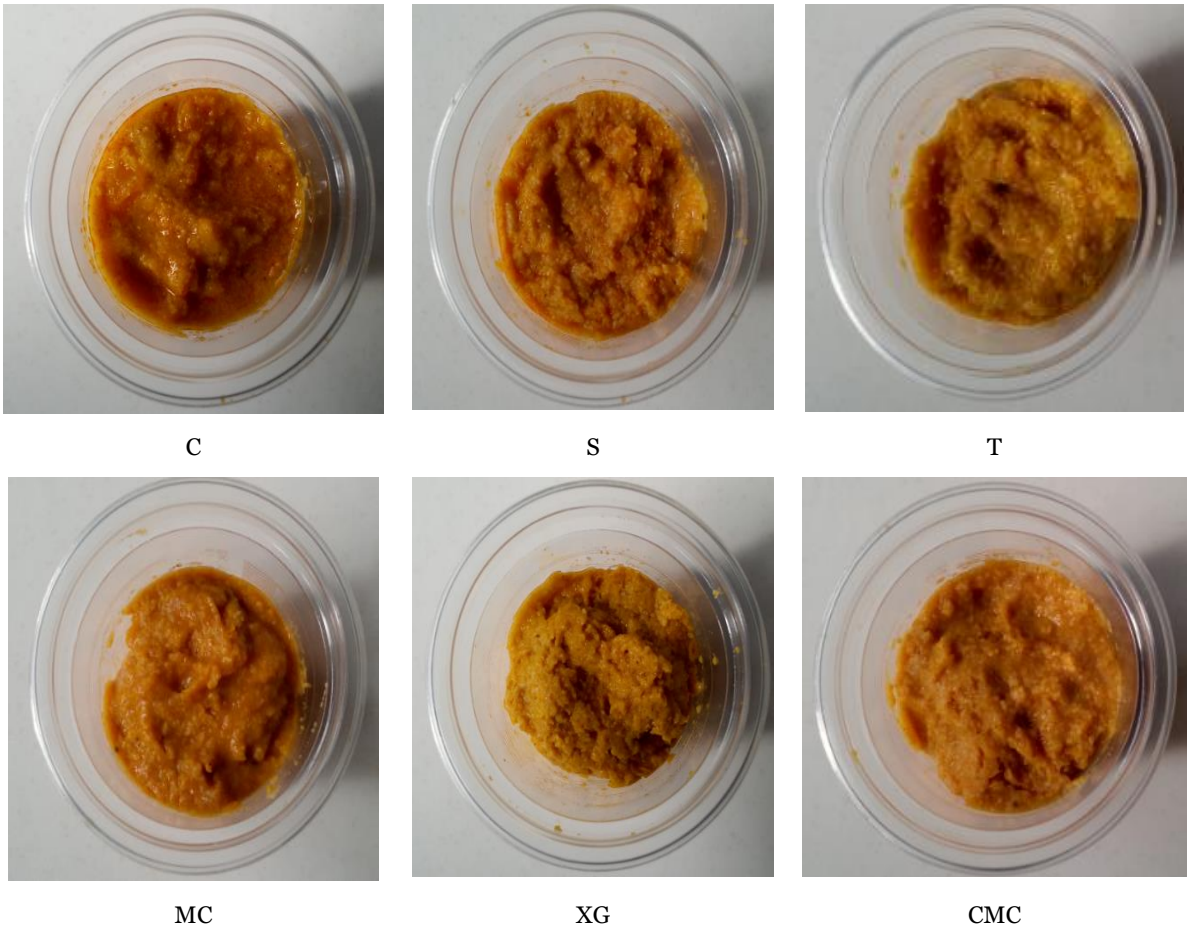

Figure 2. Samples served during the sensory evaluation includes TMCR without thickener), (C), TMCR with sago starch (S), TMCR with tapioca starch (T), TMCR with modified corn starch (MC), TMCR with xanthan gum (XG) and TMCR with carboxymethyl cellulose gum (CMC).

B. Purchase Intention, Flavour, Residue After Swallow, and The After Taste

Consumer acceptability was evaluated based on the percentages obtained from the total number of 'Yes' answer which indicates participant's liking (acceptability) based on purchase intention and flavour attributes. For attributes of residues after swallow and the after taste, response 'Yes' indicates presence of residues after swallow and the detection of starchy taste after swallow, respectively. These attributes are undesirable as residues after swallow will lead to aspiration when breathing resumes (Ong, Steele & Duizer, 2018) while the starchy taste is considered an off - flavour due to its bland taste and odour (Merino *et al.,* 2021). The ratings were represented as percentages based on the total number of 'Yes' answers obtained from all participants (Figure 3).

Firstly, for the purchase intention attribute, it refers to an individual's likeliness to buy certain product. Higher purchase intention indicates greater desire to purchase a product (Lee, Goh & Noor, 2019). For this attribute, all samples received interestingly high likings of more than 78 % of 'Yes' responses. Their willingness to buy indicates that the elderly participants had good perception on TMCR based on their sensory experience. This observation could also be contributed by the familiarity of *rendang* among the elderly participants.

Elderly are known to be difficult to impress due to their high taste threshold level (Fukunaga *et. al.*, 2005; Wiriyawattana, Suwonsichon & Suwonsichon, 2018). Fukunaga *et al.* (2005) reported that elderly had significantly higher detection threshold than younger people for all basic taste (sweet, salty, sour, and bitter).

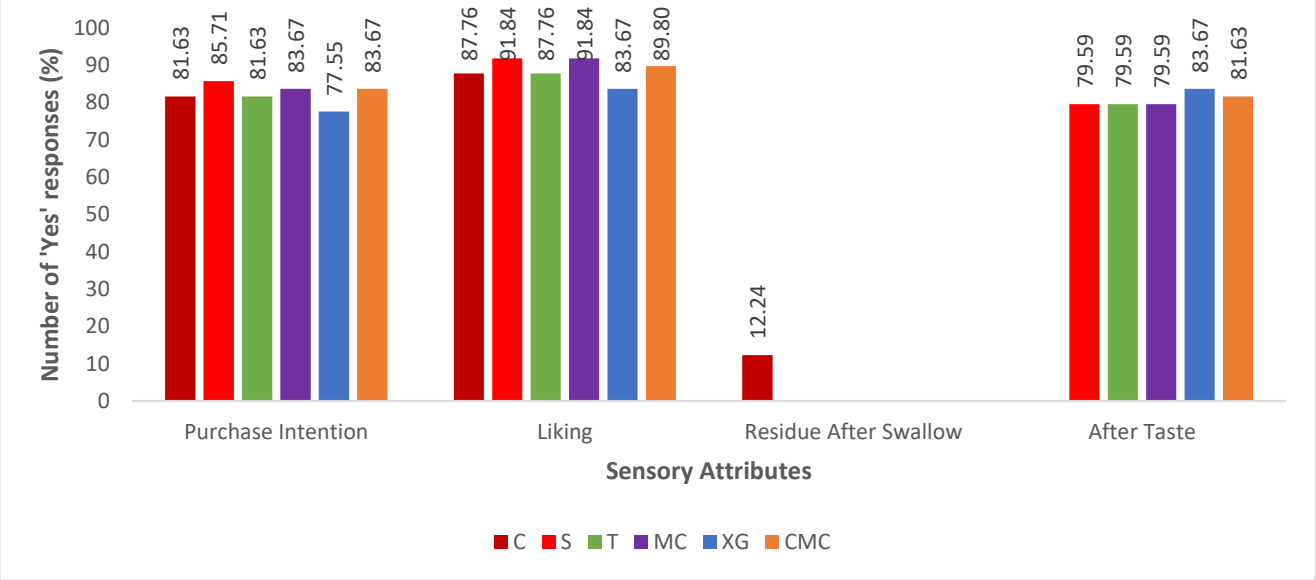

Figure 3. Likings of TMCR added with different thickeners based on categorical scale. Attributes are based on the purchase intention of the product, the rendang flavour, presence of residues after swallow and its after taste. C : control (sample without thickener) , S: sago starch, T : tapioca starch, MC: modified corn starch, XG: xanthan gum, CMC: carboxymethyl cellulose gum.

The detection threshold refers to the lowest concentration reported by participants which they were able to sense the presence of stimulant. Methven *et al.* (2012) reported that elderly people have higher threshold levels with 2 times increased for sodium salt (NaCl), 1.5 times for citric acid (sourness), 4.1 times for quinine hydrochloride, and 1.2 times for caffeine. Both quinine hydrochloride and caffeine are tastants that represents bitterness. The increase for sucrose was 1.4 times and for monosodium glutamate (umami), the threshold increased to 2.2 times.

Meanwhile, the high likings response indicates that TMCR has high market potential if the product proceeds to commercialisation stage. Acceptability of food product was previously investigated by Bryant *et al.* (2019) in relation to participant's purchasing intention of meat and plant-based meat product. The study revealed that the food acceptability has a linear relationship with customers purchase intention. According to Engel and Blackewell (1978), purchase intention is an important predictor of consumption behaviour, which is often used instead of actual behaviour (Yu & Lee, 2019). Based on these statements, it can be said that high purchase intention leads to high food intake.

Based on the result, the product with highest purchase intention is TMCR with MC (86 %), while the least liked product is TMCR with XG thickened sample (78 %). It is expected that the commercial thickener (MC) would receive the most liking as it is developed and marketed especially for people with dysphagia. The functional property of commercial thickeners has been modified to serve the purpose of adding this thickener into TMF, to be safely and efficiently swallowed without any unfavourable taste to the thickened food (Cichero, 2019; Yver *et al.*, 2018).

As for XG thickened sample, even though it is considered to have high percentages of purchase intention (83.67 %), somehow its lower ratings compared to all samples were probably due to the mouth coating effect, as highlighted by some participants during the sensory evaluation. Mouth coating effect of XG due to mucoadhesion has been reported by Fernández *et al.* (2008) and Sharma *et al.* (2017). Mucoadhesion refers to the adhesive forces occurring

between polymer material and mucus on the surface of the tongue. The interactions are due to hydrogen bonding and van der Waals forces between xanthan's anionic groups (pyruvic acid and glucoronic acid) with the mucin oligosaccharide side chains (Cook *et al.*, 2018).

The second question in the 'Yes' or 'No' part is regarding the liking of TMCR flavour. High percentages of likings (more than 80% for all samples) indicates that the *rendang* flavour of TMCR pleases the participant's taste buds. Specifically, TMCR samples with MC and T showed higher likings than the other samples. According to Norton *et al.* (2010), food flavour perception normally increases with decreasing viscosity. The fact that starch is hydrolysed when in contact with salivary amylase enzyme allows the entrapped *rendang* flavour to be released from the starch matrices and later perceived by the oral senses (Dinu *et. al.*, 2019; Naknean & Meenune, 2010). It is reported that amylose in starch can form specific complexes (inclusion complexes) with flavour molecules (Ferry *et. al.*, 2006; Guichard, 2002). During oral processing, food undergoes both chemical and physical breakdown caused by the introduction of saliva (i.e., amylase digestion) as well as by exposure to shearing forces and temperature change that leads to the reduction in viscosity (Dinu *et al.*, 2019). The breakdown of food causes liberation of flavour compounds and being perceived by the sensory receptors located in mouth and nose (Ferry *et. al.*, 2006; Salles *et al.*, 2010).

Every thickener has their own functional characteristic, which includes their ability to bind food flavour compounds within its matrices. The diffusivity of the flavour molecules is influenced by the (i) type of thickeners, (ii) viscosity of the thickeners, and (iii) physicochemical properties of flavour compounds. High viscosity relates to greater number of chain entanglements which formed barriers, separating flavour molecules from the sensory receptors. The volatility of the flavour molecules is controlled by its binding interactions with carbohydrate molecules from thickeners. Binding interactions occur due to the adsorption, complexation, entrapment inside the microregions, encapsulation, and hydrogen bonding of the flavour molecules with carbohydrate molecules (Naknean & Meenune, 2010).

Visually, both TMCR with XG and CMC looks thicker (i.e., more viscous) than starch thickened samples. Higher viscosity is related to sample's structural stability towards deformation during oral processing. Both viscosity and structural stability will affect the food's initial texture perception and influence the release of flavour compounds (tastants) into mouth, to be perceived by the oral receptors (Adams & Taylor, 2012; Kaklamanos *et. al.*, 2016; Madene *et al.*, 2006). According to Brunchi *et al.* (2016) and Naknean and Meenune (2010), interactions of the intra – and intermolecular hydrogen bonding between side chains and the main chain of gums, created carbohydrate molecules with hydrophobic interiors which entrapped flavour compounds. During the oral shearing and salivary mixing, polymeric chains get disentangled, and flavour compounds diffused into the oral cavity (Makame *et al.,* 2019).

Between both gums, XG thickened samples obtained lower likings of flavour than CMC thickened samples, partly due to the mouth coating effect which influenced the perception of flavour (Samavati *et al.*, 2012).

On the other hand, CMC gum is known to have a neutral inherent taste and odourless, hence renders its suitability as a flavour additive (Ma *et. al.*, 2013; Sharma *et al.*, 2017). Salari *et al.* (2017) reported higher concentration of XG in sample showed reduction in taste scores compared to the same concentration of CMC with no undesirable changes on the taste of cream cheese. Moreover, the rigid rodlike structure of XG, as well as its higher hydrophobic property owing to the trisaccharide side chains (glucoronic acid and pyruvic acid groups) makes it less easily disrupted and less miscible with saliva compared to the flexible chains of CMC (Naknean & Meenune, 2010, Joanna *et al.*, 2017). According to Choi *et al.* (2014), the inability of XG filament to be miscible with saliva displayed an uneven thinning effect due to the large size of xanthan's molecules which are about 1 μm in length. Meanwhile, for control sample, the liking of flavour was seen lower than all thickeners except for XG. This could be due to the lower intensity of flavour detection, resulted from unrestricted release of some volatile compounds during processing. As stated by Madene *et al.* (2006), some of the flavour compounds especially the aroma degrades or loss during processing and the addition of thickener helps to retain by entrapping the flavours in time.

With regards to the presence of sample's residues after swallow, all thickened samples did not leave any residues

except for control sample which was encountered by a few participants (12% ratings). The absence of residues in thickened samples clearly indicate that thickeners provide cohesive properties between food particles (Seo & Yoo, 2013), thus the food does not disintegrate easily during consumption (Sharma *et. al.*, 2017; Torres *et al.*, 2019). If the food particles easily disintegrate, there is a chance of having residues, causing both fractional as well as misdirected swallows (Nystrom *et. al.*, 2015; Vilardell *et al.*, 2016). Both authors and co-workers proved that the addition of thickeners had improved the efficacy of swallowing, as shown by the absence of residues and fractional swallow. The results are supported by Marconati *et al.* (2019), whom the authors reported that thickeners would act as a vehicle to suspend the multi particulates, allowing for smooth flow of bolus while ensuring complete oral clearance of the solids (i.e. no post swallow residues).

Lastly, the starchy taste in the samples was evaluated. After tasting, TMCR with XG was reported to have the highest starchy taste after swallowing with 84 % ratings. Some participants commented about the presence of an undefined taste after consuming TMCR with XG sample which they guessed as feeling starchy. However, it was due to the mouth coating effect of XG. Similar mouth coating effect was also perceived in a carrot puree as reported by Sharma and Duizer (2019).

Meanwhile, starch thickened samples were perceived to have less starchy taste after swallowing. This finding could be due to the fact that starch had been digested by the salivary amylase during consumption, thus causing the entrapped *rendang* taste to be totally released, which could have overpowered the starchy taste.

From this study, although the results were insignificant, it can be seen that different thickeners do exhibit different sensory properties. The insignificant difference between the results entails further study using descriptive test to substantiate the findings obtained from this study.

IV. CONCLUSION

All samples shown to receive high acceptability among the elderly panelist. Thickened samples was found to provide an easy and safe swallowing due to their viscous and shear thinning properties as well as cohesivity, leading to the absence of residues after swallow, thus minimising the risk of aspiration. The detection of starchy taste or mouth coating effect in all thickened samples did not seem to hinder participant's liking based on purchase intention and sample's flavour, which gained more than 79% and 85 % likings respectively. This clearly indicates that the elderly panellists have a good impression on TMCR and seems to like the samples irrespective of the types of thickeners. These findings showed that TMCR has a promising prospect for commercialisation.

V. ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Higher Education, Malaysia for funding this research under the Fundamental Research Grant Scheme (FRGS/1/2018/STG01/USM/02/7).

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