FACTORS AFFECTING ACCEPTABILITY AND IDENTIFICATION OF PURÉED FOODS

By

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To my husband and parents

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Abstract of Thesis Presented to the Graduate School
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Puréed foods are recommended for persons with dysphagia, mostly older adults. Age-related changes in chemosensory perception combined with texture modification makes recognition of puréed foods challenging. Few sensory studies have been done in this field, yet with advancements in both food processing and product development, sensory evaluation of commercial purées is imperative for continued improvement. Inability to identify purées is a common complaint for these individuals and may negatively impact consumption and quality of life. The objective of this study was to evaluate the influence of age on identification and acceptability of purées. Four sensory panels were conducted with young panelists (18-35yr; n=90-100) and older panelists (>60yr; n=50-72) using the hedonic gLMS. Various purée qualities were evaluated, including shaping, sodium content, and presentation. Our results are in agreement with previous studies on identification, that young panelists were better at correctly identifying purées. Unformed purées were more acceptable than shaped purées, which may provide a cost advantage. Identification and acceptability improved when purées were presented separately rather than combined. Reduced sodium purées were

equally acceptable to their higher sodium counterparts. Conventional purées received greater acceptability scores when compared to non-conventional purées. These results have several implications in product development of commercial purées. Purées should be created as individual foods with optimal sensory qualities. They do not require shaping, and bread purees may be prepared with less sodium. Producing foods that are commonly consumed as purées could be more nutritious and acceptable. These findings highlight the need for puréed food product development.

CHAPTER 1
INTRODUCTION

Dysphagia is a condition characterized by impaired or difficulty swallowing that occurs either at the oropharyngeal or esophageal phase. It is most commonly the result of cerebrovascular injury (stroke, head trauma) and neurodegenerative disease such as Parkinson's and multiple sclerosis. It has also been highly associated with radiotherapy in the treatment of head and neck cancers. Management of dysphagia is generally a multidisciplinary approach including nutrition management and therapy to improve swallowing function. In some instances, surgery and/or other medical interventions are indicated (Lister 2006). The prevalence of dysphagia is highest in the elderly population, with approximately two-thirds of dysphagia patients being age 65 or older (Ginocchio and others 2002).

According to the U.S. Census Bureau, the percentage of individuals age 65 and older will rise from approximately 12.4% in 2000 to just over 20% in 2050 (U.S. Census Bureau 2004). With an ageing population, emphasis on dysphagia management becomes increasingly relevant, as dysphagia incidence is not only highest for elderly persons but is also prevalent within this population. Multiple studies demonstrate that for persons over age 50, dysphagia occurrence is approximately 15-35% (Chen and others 2009; Roy and others 2007; Lindgren and Janzon 1991). The large variation indicates differences in sample demographics, methods to obtain data, and possible disparity in definitions of dysphagia. Nonetheless, these data suggest a noteworthy group of affected individuals.

While abundant research exists in the field of dysphagia, most is focused on the clinical facets of the condition such as diagnosis and medical intervention. Few papers

have been published in sensory evaluation of the texture modified diet, the approach for nutritional management of this condition, and its impact on quality of life (QOL). In many cases, the modified texture is puréed, where all foods must be blended to a smooth consistent texture before consumed. Although limited, existing research clearly shows puréed foods are poorly accepted and adversely impact QOL (Blaise 2009; Schiffman 1977; Schiffman and Warwick 1989; Schiffman and Warwick 1993). Given this is a concern for individuals with dysphagia currently, imagine the magnitude of the issue if research in this field remains stagnant while the number of dysphagia cases considerably increases as the populace continues to age.

Specifically, this research will target identification and acceptability of puréed foods. Few papers have been published on puréed food recognition; in fact, the most recent paper is from the mid-1980s (Schiffman 1977; Murphy 1985). Given the inability to recognize a puréed food has been associated with a negative mealtime experience for elders, this is an area which needs to be investigated further (Blaise 2009). Current studies on puréed food recognition compare young versus older subjects and highlight age as a factor influencing correct identification. However, acceptability and preference of these puréed foods have been neglected. These studies also removed the visual element by not allowing subjects to visually observe the purées. Not only is this an unnatural way of eating, but elders have been shown to rely more on visual cues to recognize foods (Philipsen and others 1995). There is also contradictory evidence surrounding the use of shaped versus unshaped puréed foods, an area which would also benefit if researched further.

The current research study will fill these gaps by not only examining identification of puréed foods but asking more importantly, is the purée acceptable? Is the additional "shaping" step necessary? Are puréed foods better served individually or combined? How do low sodium products compare to regular? Should we focus more on conventional puréed foods to increase acceptance and possibly consumption? Answers to these questions will be explored through sensory evaluation using comprehensive sensory panels. This research project is made up of four smaller, individual studies. There are two primary objectives with several secondary aims specific to each of the four different studies. The first primary objective is to evaluate the effect of age on identification of puréed foods. It is expected that younger persons will identify more correct items than older persons, especially when the visual element is absent. Second, this project examines the possibility of a relationship between identification and acceptability. It is expected that correct recognition of a puréed food will be positively correlated with increased acceptability. The four studies within the project evaluate various characteristics of puréed foods, including appearance, preparation styles, sodium content, and food type. Each of these will be explained in further detail in subsequent chapters.

As with any food product, there is always room for improvement, especially if the product is consumed at every meal, as are purées for those on a texture modified diet. The results of this research have the potential to substantially affect multiple fields, including but not limited to, health and wellbeing of dysphagia patients, product development, and nutrition management of dysphagia. A better understanding of what is both accepted and preferred may lead to development of improved products, both

commercial and in-house prepared. Ultimately, the outcomes from this research will ideally enhance the meal time experience of individuals with dysphagia on a puréed diet and improve their QOL.

CHAPTER 2
LITERATURE REVIEW

Food Preferences and Acceptability

While there are many factors that affect what an individual eats including economic, cultural, familiarity, nutrition and convenience, one of the most influential factors is personal food preference or the selection of one food over another (Laureati and others 2006). While preferences may be shaped by these factors and others, it is the sensory attributes of a food product that are of utmost importance. However, why one product is selected over another may not always correlate with the sensory preference of that food item (i.e. the one that tastes, smells, and appears the best). Nonetheless, a food's taste, aroma, color, texture, and chemical irritation have been consistently documented in the literature to have a significant impact on food preference.

Another major factor influencing what an individual eats is acceptability, or the level of satisfaction with a given food. Acceptance of a food product is closely linked with food preference in terms of sensory analyses and provides a more complete picture as to why certain foods are consumed. For instance, when comparing varieties of apples, a panelist may prefer one apple over the other but provide low scores in acceptability because that individual does not like apples. Clearly, preference and acceptability are two distinct features. Both are required to understand fully the rationale for food selection.

Preferences and Acceptability: General

In surveying focus groups of institutionalized elderly, Laureati and others found that elderly ascribed sensory qualities as the most important consideration in food

preference and acceptability (Laureati and others 2006). Specifically, in respective order of preference, elderly chose taste, aroma, appearance, and texture (Laureati and others 2006). Alternatively, Hall and Wendin (2008), found through focus groups that discernible food components, consistency/ease of swallowing, appearance, powerful flavor, and nutritional quality were the most important factors in food acceptability (Hall and Wendin 2008). However, the focus groups in this study were “experts” in the field of dysphagia who provided their opinion on what elderly would deem important for food preference and acceptability. While the elderly group chose factors they deem relevant in food choices, it is possible that some of the criteria listed from the expert focus group (i.e. ease of swallowing, discernible food components) are inherent in the actual food choices and were simply not recognized by the elderly group.

As taste and aroma seem to be recurring factors of importance, it is important to note that decline in gustatory and olfactory senses with age is well documented (Drewnowski 1997; Fillion and Kilcast 2001). It would seem logical then, that with limited olfaction/gustation abilities, reliance on other sensory attributes such as appearance and texture as a compensation mechanism would assume a greater role in food preference and acceptability. Forde and Delahunty (2004) found that when compared to a younger cohort, the older group’s acceptability of the orange juice sample was more strongly correlated with the pulp or “thickness” of the sample, implying a possible connection between texture and acceptability (Forde and Delahunty 2004). As similar juices were liked by both the older and younger group, the researchers stated that “sensory deficit does not necessarily influence liking”, suggesting the extent of importance texture has on acceptance regardless of full or limited olfaction/gustation.

Nonetheless, it is also important to note the older group was not able to distinguish between samples in reference to their liking score (Forde and Delahunty 2004). Such a finding implies the older subjects were reliant on fewer sensory attributes and therefore had a more limited perspective on all of the sensory qualities needed to discern samples.

A similar finding was found in one of their earlier studies, where older subjects were less able to discriminate texture variation between samples than younger subjects. However, unlike the first study, texture or “thickness” of the sample was not significantly related to preference (Forde and Delahunty 2002). However, only one respective food from several textures (liquid, semi-solid, and solid) was presented, and these results may be different for foods in which we would expect texture to play a primary role (i.e. meat products, dry/crunchy foods, etc.) in food acceptability. Based on these contradictory findings with regards to texture and food preference, more research needs to be done in this field.

Regardless of the impact texture has on acceptability for those with reduced olfaction and gustation, aroma and taste qualities are still important to the eating experience. Aroma includes odorous substances while taste is made up of sweet, salty, sour, and bitter (Taylor and Roozen 1996). Taken together, these attributes make up what is perceived as flavor. Flavor perception is therefore dependent on these variables and may be enhanced or diminished when aroma or taste is altered (Taylor and Roozen 1996). This may have implications for older adults who have decreased sense of aroma and taste and therefore of flavor perception (Schiffman 1993).

One of the most important nutrients, both in terms of flavor perception and health, is sodium. Reduced sodium diets are frequently recommended for older adults for various factors including increased age, medications, and medical conditions such as hypertension, CHF, renal disease, among others. Nonetheless, salt is often crucial to optimize flavor perception. Salt is often added to food in order to increase volatile headspace which in turn enhances flavor perception (Guichard 2002). The threshold for salt (as NaCl) has been shown to be significantly greater for elder adults when compared with young (Mojet and others 2001). In general, the threshold for sodium salts in older persons is nearly 12 times higher on average when compared to young persons (Schiffman 1993). Consequently, older adults require this increased sodium concentration for optimal flavor perception yet are often simultaneously on reduced sodium diets, which may have serious consequences. Older adults may end up consuming excess salt to compensate for what is perceived as reduced flavor. It is also possible that consumption will decrease as a result of foods seeming bland. Either way, this is a nutrient of concern, especially in the older population.

Acceptability in Texture Modified Foods

As acceptability of foods are primarily evaluated on the basis of sensory parameters for the general population, acceptability of modified texture foods extends beyond sensory attributes for individuals with dysphagia. These foods often constitute the individuals diet in its entirety and as such, play a significant role in daily life. It has been shown that for those on texture modified diets, regardless of extent of modification (i.e. chopped, minced, puréed), there is a decreased quality of life (McHorney and others 2002). Perhaps, this is due to personal embarrassment for needing such a

specified diet, the inconvenience associated with food preparation and/or procurement, or the disjoint between expected and actual texture of familiar foods.

Therefore, increasing acceptability of specialty foods for individuals with dysphagia could be one way to improve quality of life. It has been well documented that noncompliance with a modified diet is a recurrent issue for patients with dysphagia (Colodny 2005). Further, in a survey of noncompliant individuals, it was found that second to outright denial of a swallowing problem, the most common claim for noncompliance was dissatisfaction of the food product, further corroborating the need to improve the food products themselves as a step towards increasing perceived quality of life (Colodny 2005).

Food Identification

Most people do not consider food identification as part of the eating experience, as it is generally not a mystery what food item is being consumed and is therefore inherent in sensory assessment for preference and acceptability. However, in the absence or alteration of one attribute in an otherwise familiar product, such as with texture modified foods, identification becomes increasingly difficult. This is because the senses work in a complex system in recognition of a food product, which can ultimately influence one's perception of that product and potentially change preferences/acceptability (Murphy 1985). Whether one conscientiously realizes it or not, memory of a food product is related to all of its sensory attributes and it is this combination that allows one to not only identify a product but assess its acceptability (Scott 2005). Therefore, acceptability may be altered when a product is not recognizable.

Identification: Introductory Background

There are many tests to evaluate sensory-cognitive interaction and accuracy. One such test utilizes the principle of oral shape recognition, where identification of a shape placed on the tongue is done without the use of tactition or visual influence. Fillion and Kilcast (2001) utilized this form of testing with alphabet letters made of sugar icing, where participants were asked to identify the letter using only oral manipulation. They found that adults age 65 and over were significantly less able to identify correct letters when compared to young adults (Fillion and Kilcast 2001).

While this study examined sensory integrity based on non-food items, several studies have looked at identification specifically with foods. Although taste and aroma may be perceived as the most important attributes of a food's acceptability, it appears that appearance and texture are crucial for correct identification of foods, which in turn can impact acceptability (Imram 1999). As a result, the influence of appearance and texture modifications on identification is examined here.

Identification: Color Modification

Color has been shown to have significant effects on correct identification of fruit flavored beverages (Dubose and others 1980). Correct scores increased as color went from inappropriate (i.e. green color, orange flavored beverage) to appropriate (i.e. orange color, orange flavored beverage). Moreover, in assessing the influence of color on flavor, intensity of the color (of the appropriate color) was correlated with increased overall acceptability (Dubose and others 1980). Philipsen and others (1995) found similar results, though they also included the variable of age by using subjects of a young and old cohort. Identification of a cherry-flavored beverage declined as several samples with color of varying intensities went from red to yellow. Moreover, *perceived*

flavor intensity and overall acceptability increased as color progressively became more representative of the actual flavor. This was true for both age groups, but to a much greater degree of older subjects, indicating substantial “reliance on visual cues” (Philipsen and others 1995).

Thus, color affects not only identification but acceptability as well. A product that is presented with its expected color (as obtained from previous experience with the food item) will be more likely identified and more acceptable. Whether or not identification and acceptability are merely correlated or dependent on one another is an area that needs further research.

Identification: Texture Modification

While appearance has been shown to play a significant role in recognition of foods, texture modifications have been extensively researched, especially in regards to those with dysphagia, of which this review is aimed. In a qualitative study of observations, patient chart reviews, and patient/staff interviews, it was found evident that difficulty in recognizing foods in puréed form was negatively associated with the meal time experience (Blaise 2009). Patient’s reported the separate food items as having too similar taste and texture, and one even equated it to “baby food”, clearly signifying a disliking for the product. While there are likely additional variables contributing to the negative mealtime experience for individuals on puréed food diets, inability to identify the food item was cited as the most important factor from the patient’s perspective (Blaise 2009). It appears then, that identification of a food item is inherently associated with its acceptability.

Schiffman (1977) found significant differences between young and older subjects in correct identification. Subjects were blindfolded, asked to smell and taste the product,

report its identity, and rate the extent of intensity of the aroma/flavor stimulation. Not only did young subjects report the actual food item correctly more often than older subjects, they were also more likely to guess the correct food group when a misidentification was made. Further, older subjects reported significantly less intensity of both taste and aroma when compared to the young, though to a greater degree for aroma (Schiffman 1977). This supports the idea that gustation/olfaction decline with age and ultimately influence sensory perception. This may be especially true with modified texture foods, where reliance on taste and aroma predominate in food recognition.

As a follow up to Schiffman's study, Murphy (1985) utilized several of the same food items and followed the same procedure with one exception. Rather than conducting one session of identification, Murphy used several sessions, where the first was modeled after Schiffman's work, while subsequent sessions provided feedback to subjects regarding correctness in their response. The purpose was to assess cognitive ability in identification, as reduced ability of older subjects to correctly identify foods could be due to a decline in cognitive function associated with age rather than sensory losses (Murphy 1985). Essentially, poor identification could be related to poor memory retrieval of a food item. Further, while significant differences in correct identification occurred between age cohorts when subjects were allowed to both taste and olfaction, this was not the case when the factor of smell was taken away (Murphy 1985). Thus, these two studies agree that olfaction likely has a greater impact on identification than does taste.

Another key finding from Murphy's study was that upon subsequent sessions with feedback on correctness and repeated exposure to the same food items led to increased identification for both young and older subjects. However, young subjects improved significantly more than older subjects in subsequent sessions, suggesting a lack of cognitive ability in the older adults as an explanation for the discrepancy (Murphy 1985). This finding extends Schiffman's work, in that it implies cerebral recognition is innately part of identification, as it relies not only on sensory attributes but also on cognitive function.

Another study on identification of texture modified foods found comparable results to both Murphy and Schiffman's work. In assessing naturally-prepared puréed food items (i.e. without added cornstarch or spices/seasonings), Bischmann and Witte (1996) found there was a significant difference in correct overall identifications for young adults when compared with older adults. Further, younger adults performed better than older adults in identifying nine of the ten items correctly. It is possible the older group identified one item better than the other due to familiarity of the product, as an item served in the retirement home from which older subjects were recruited (Bischmann and Witte 1996).

It is important to note that it is quite possible that confounding variables such as decreased dentition, declining health/cognitive status, and increased use of medications, that are more prevalent in the older population, could influence sensory perception and therefore ability to correctly identify food items (Mioche 2004). It is therefore critical to take these variables into account, as was so adeptly realized and executed in previous research (Bischmann and Witte 1996). Moreover, other variables

that could influence sensory perception but that are not necessarily associated with age (i.e. smoking) were also considered (Bischmann and Witte 1996). With a substantial group of possible confounding variables being eliminated via statistical analyses, the validity in their results is greatly augmented.

While there are a limited number of studies examining food identification, it seems apparent this is a skill that declines with age, at least when one or more sensory characteristics is removed as a variable. While it has not been studied, one would assume that a young and older person comparing two food groups that contain all expected sensory attributes (taste, aroma, appearance, texture) would be able to equally identify the product. Nonetheless, the sensory attributes the older person may rely on more in identification may differ from the younger group who generally have a different sensory profile. In effect, an older person may use more visual and textural clues which have not been as affected by age in identifying a food product while a young person is more likely to use each of the senses more equally (Imram 1999; Forde and Delahunty 2004).

Methods to Improve Identification and Acceptability

As the dominant trend appears to be that elder persons have a decreased ability to correctly identify foods and a decline in olfaction/gustation, several attempts have been made to improve or enhance foods in order to augment identification and acceptability of food products for the older population, especially for those with dysphagia. If there truly is a compensation effect and the decline of one sensory attribute leads to reliance on other features, we would expect older subjects to rely primarily on appearance and textural cues. However, in puréed foods, texture and appearance are both modified and reliance on taste and aroma then becomes crucial in

yielding any form of familiarity for recognition and acceptance. Thus, with limited olfactory and gustatory systems, elderly individuals on a puréed diet may benefit from the enhancement or manipulation of taste and aroma. Moreover, as visual cues have been shown to improve elderly identification of food products, perhaps manipulation of appearance in a typical puréed food may improve acceptability as well.

Sensory Enhancement: Flavor

Flavor enhancement to improve acceptability has been widely researched. A flavor enhancer is any substance that increases the intensity of the flavor already present, for example, monosodium glutamate (MSG) (Schiffman and Warwick 1989). In comparing young versus elder subjects, one study found it took a greater percentage of flavor concentration to perceive the same level of intensity for the elder group. The elder subjects preferred the higher intensity flavor, though to a varied degree dependent on the food product (deGraaf and others 1996). These findings suggest that elderly would prefer flavor-enhanced foods, though the exact flavor intensity would depend on the food item in question. Additionally, Laureati and others (2008) found elderly preferred foods that were fortified with flavor enhancers when compared with unfortified products and younger subjects (Laureati and others 2008).

In another study examining the effects of flavor enhancement, several food items were prepared, each with a high and low concentration (and thus intensity) of flavor, and then rated and selected based on preference. The results show that the older cohort preferred the high flavor concentration for samples while the young preferred the low concentration (Griep and others 1997). While these findings support the idea that enhanced flavor is preferable among older individuals, the researchers also make the claim that flavor enhancement may “change food preferences” (Griep and others 1997).

This claim should not be extrapolated from these results, as preference was only between samples and not for overall food preferences related to dietary intake.

Flavor amplification has been shown to be preferable and lead to increased consumption by elderly (Schiffman and Warwick 1989). This could be explained by a compensation effect for decreased olfaction and gustation (Schiffman and Warwick 1993). It appears from these results that flavor enhancement could indeed improve acceptability of food products designed for an older population. However, it is also should be noted that none of these products were puréed foods and it is possible that flavor enhancement would not produce the same effect. Therefore, research on flavor enhancement of puréed foods would be valuable.

Sensory Enhancement: Appearance and Texture

In an effort to improve acceptability of texture modified foods, the use of shaping molds to give the food its characteristic shape have been employed. Shaped purées are produced to emulate the same appearance qualities as the non-puréed food counterpart. There are mixed results regarding the effect these molds have on acceptability. One study, which examined residents in a long term care facility, provided on two separate occasions both typically-prepared and molded forms of puréed foods. The foods were from the same menu cycle and given to the same residents to maintain validity. They found residents' consumption and acceptance was greater for the molded puréed food. However, they also note that staff may have indirectly influenced residents' perception and consumption by making positive comments on molded forms (Cassens and others 1996). Conversely, preliminary data from Stahlman and others (2000) indicate sensory qualities (appearance, taste, texture) of molded fruits have significantly lower ratings than unmolded (Stahlman and others 2000).

Contradictions for Sensory Enhancement

Contrary to the many studies described above, several studies have found enhancement of food products to be negatively associated with acceptability. This could be explained by the idea that appreciation may not be affected by sensory decline. As the decline in sensory acuity is a gradual process, elderly are often unaware and simply adapt over time (Wysocki and Pelchat 1993). Thus, despite actual differences in perception of intensity of an aroma/flavor, an elderly person may have adjusted to the lower intensity and therefore appreciate it better.

For instance, enhancement of aroma in food products did not have a significant effect on overall pleasantness for the elderly group in a study on flavor and aroma enhancers (Koskinen and others 2003). Initial responses indicated unpleasantness with increased aroma; however, in a second trial the same sample was associated with increased pleasantness. The researchers suggest this could be a result of adjustment to the aroma, given the fact elderly did not discern between samples to the same extent as the young group. The net result was that enhanced aroma did not increase acceptability as proposed in other studies (Koskinen and others 2003). Other research has found that despite documented decreases in taste sensitivity, there were no significant differences in preference of flavor heightened food products of elderly versus young; rejecting the idea that enhanced products would be favored by the elderly with decreased sensory capabilities (Mojet and others 2005).

Contradictions to enhancement of texture and appearance have been documented as well. Since molded fruits received negative feedback for taste and texture in the preliminary study by Stahlman and others (2000), additional research was conducted to assess the thickener (added to molded forms to provide stability in

maintaining shape) as a possible influence (Stahlman and others 2000; Stahlman and others 2001). In the subsequent study, a comparison between typical puréed food, puréed food with added thickener, and molded puréed food were assessed to evaluate influence of appearance, taste, texture, and overall acceptability. The typical puréed food without thickener was rated highest in all of these categories, contradictory to other results (Stahlman and others 2001; Cassens and others 1996). A possible explanation for increased preference of the non-thickened typical puréed food is that it did not contain the thickening agent, which likely negatively impacted taste and viscosity of the product from the subjects' perspective.

Additionally, typical puréed foods (with and without thickening agent) were rated higher in appearance than the molds, which could conceivably be due to higher expectations imparted on the shaped versus the unshaped puréed food. In essence, if one visually sees a puréed food, there is likely an expectation of a purée. However, if one sees what appears to be a peach yet the taste and texture are different from a true peach, there may be more negative associations with that molded peach, as it did not live up to its expectation (Stahlman and others 2001).

Acceptability with Age-Related Sensory Decline

It appears then, the idea behind enhanced products, whether for aroma, taste, or texture is a more complex dilemma and is inconclusive at this time. Indeed, Laureati and others (2008) found that while the young subjects had high sensory capabilities in taste and odor identification, the elderly subjects varied in their sensory integrity (Laureati and others 2008). As a result, the older group was subdivided into low and high scoring groups. Nonetheless, the young significantly scored better than even the high scoring older subjects. The researchers propose that despite substantial sensory

decline of older persons when compared to young, there is extensive variability between this group of individuals and thus, elderly persons should not be considered as a single "homogenous group". In fact, other researchers have similar results—that there is great individual variation in the extent of olfaction/gustation reduction with age (Forde and Delahunty 2004). This could perhaps offer one explanation as to why flavor-enhanced products have been found preferable and non-preferable in multiple studies; namely, that a group with higher sensory capability may prefer a more traditional product while those with lower sensory functioning may compensate by favoring enhanced products.

It is also key to point out that several studies have found participants across age groups preferred similar formulations of a food sample, despite reduced taste and aroma perception of elderly subjects (Booth and others 1989; Forde and Delahunty 2004). This finding may imply preference is not associated with a decline in sensory perception. Thus, preference may rely more on components of flavor/aroma rather than intensity, which would be a counterargument towards enhanced foods. The researchers also suggest that as a result of this finding, flavor amplification of foods may actually negatively impact acceptability for two reasons. First, flavor enhancement may change the composition of flavor constituents and therefore lead to a product that is less preferred, and second, for any individual who has a lesser degree of sensory loss due to age, amplification of flavor in a food product may yield a flavor that is too intense and undesirable (Booth and others 1989).

Sensory Testing

The most traditional and widely used scale in sensory preference and acceptance testing is the 9-point hedonic scale. This relatively simple to use categorical scale that is equally balanced between two end anchors of "dislike extremely" to "like

extremely” with a neutral “neither like nor dislike” category at the center. The primary advantage of this scale is due to its simplicity, both for the researcher and participant, as well as consistently proving to be effective (Lim 2011). Nonetheless, there are several limitations to using the 9-point hedonic scale in preference and acceptability studies, especially across different groups of individuals. The largest limitation of a categorical scale such as the 9-point scale is that intensity responses are relative and thus may vary from person to person (Bartoshuk and others 2005).

With the discovery of differences in taste perception (including non-tasters and supertasters), researchers tested and realized that perhaps categorical scales were not capable of capturing relative differences in individual sensory experiences, including with eating. As a result, new scales were created to solve this dilemma, including the hedonic general labeled magnitude scale (HgLMS). The most recent version of this scale provides a bottom anchor (-100) representing the “most intense displeasure of any kind ever experienced” to a top anchor (+100) equating to the “most intense pleasure of any kind ever experienced” with a (0) neutral mark at the very center (Bartoshuk and others 2002). Persons using the scale select those experiences which best fit the description and these represent that one individual’s end anchors. Thus, the scale will vary from person to person.

As individuals, we all have very different sensory and life experiences, and as such, the intensity to which a food experience is perceived will likely vary as well. For example, one person may anchor the scale from “death of a loved one” to “getting married” while another person may have anchors ranging from “breaking an arm” to “getting into college”. With these varied experiences, it is likely that the acceptability of a

food product would rank in very different places on the scales for these two individuals. Nonetheless, expert opinion suggests individuals rank favorite food similarly, with an average rating of approximately 65-80 (Sims 2013). The scale is dependent on the hedonic experiences selected by the user, which are generally not food related (though they may be). As such, the scale allows for cross comparison between different groups of people who have different experiences (Bartoshuk and others 2004). Food is just one area of hedonic acceptance and preference, and the relative intensity to which a food is ranked will ultimately vary from person to person, depending on personal experiences. In using the HgLMS, it is expected to pick up on these variations.

Summary

Decline in chemosensory perception has been well documented but the relation of this decline to food acceptability and preference is still lacking (Drewnowski 1997). Further, decline in one sensory attribute affects the entire sensory perception of a food product, as sensory attributes are not single units functioning alone but rather work in unison as a complete system (Murphy 1993).

Most frequently documented is the decline in olfaction/gustation sensory attributes. Mioche (2004) describes there is less of a decline in textural perception with age, despite a decline in chewing efficiency due to decreased dentition and saliva production, that are associated with aging. Further, while oral manipulation and mechanism of chewing differed for elderly and younger subjects, there were no significant differences in the end result of texture perception (Mioche 2004).

Nonetheless, for elderly individuals with dysphagia, not only are olfaction/gustation reduced due to age, but texture is modified in the products they consume as well. Consequently, we would expect this accumulative effect to

considerably reduce the overall perception of a food system. How this then affects food acceptability is the next concern.

Moreover, while identification studies have been extensive with regards to comparison between young and old and examination of the variables affecting ability to recognize a food system, it still remains to be evaluated whether or not identification influences acceptability. Given lack of identification was cited as one of the primary reasons for a negative mealtime experience, it seems logical to look into acceptability as it relates to identification, specifically in purée food systems (Blaise 2009).

CHAPTER 3
METHODS AND MATERIALS

Panelist Recruitment

The University of Florida Institutional Review Board (IRB) classified the study protocol as exempt and thus no further documentation was required. Two age groups were recruited, including a young cohort (age 18-35) and elder cohort (age 60 and older). Panelist screening was done to exclude individuals with specific food allergies and/or who did not consume beef, pork, or poultry products, as these would prevent panelists from tasting some of the samples. Young panelists included University of Florida students and staff who were recruited through a panelist listserv of past sensory testing participants. Elder panelists were recruited from the community in Ocala, Florida. Four objectives were evaluated, which are subdivided into Studies 1 through 4. The same group of panelists was used for each study, though not all participants were able to make it to every sensory panel. Panelists were not required to attend every session, though participation was encouraged. This was not the case for Study 2, which was made up of two sessions. Compensation was provided for each panel attended, regardless of inclusion into the data.

Pureed Food Selection

Puréed foods to be studied were selected on the basis of the four objectives evaluated in each study. A variety of foods were chosen to account for potential preference differences. Samples were commercially-produced, ready-made or ready-to-prepare puréed foods. All samples were handled or prepared using appropriate food safety procedures. Each specific food is described in more detail under the

corresponding study section. Purées were served at room temperature for optimal flavor perception (Ventanas and others 2010).

Sensory Testing

Sensory testing was conducted at different locations for each age group. Young panelists evaluated samples in the sensory laboratory at the University of Florida. The lab is made up of individual booths with computer stations equipped with CompuSense® five Sensory Analysis Software for Windows (Compusense, Guelph, Canada). Copies of individual paper scales and a pencil were provided to panelists for reference. Elder panelists met in Ocala, Florida at two separate locations, as a result of participant availability and transportation. One group evaluated samples in a large banquet hall at a local church while the second group tested in a major conference room at the University extension office. Individual booths were not available, so panelists were seated an appropriate distance apart at long tables facing the same direction. Panelists were also instructed not to converse during testing. Paper scales and ballots were provided for testing, in addition to pencils.

For both groups, unsalted crackers and deionized water were provided as a palate cleanser. Panelists were instructed to have a bite of cracker and sip of water before each sample. A spoon and napkin was also provided to each panelist. All samples were assigned a random three-digit code. With the exception of the shaped purées in Study 1, scoops of varying sizes were used to distribute samples into 4-ounce clear plastic cups. Samples that were transported to Ocala were covered with a lid. Shaped purées were presented on a small paper plate in order to keep the shape intact. Panelists were instructed to consume a sufficient amount of the sample in order to answer questions.

Questionnaire and Training

A training session was provided during the first panel, provided by brief training at each subsequent panel. If a new panelist participated that had not done the panel before, that panelist was given individual instructions on how to use the scale and proceed with testing. During the first training session, participants were briefed on the primary objectives of the study but without any indication as to the types of food products that would be tested, other than that samples would be puréed foods. Next, the scale was introduced, which was the hedonic gLMS.

Each panelist was instructed to create his/her own personal scale by selecting anchors that best describe the strongest disliking and strongest liking ever experienced. These events represent the bottom (-100) and top (+100), respectively, of each person's individual scale. A value of 0 indicates neither liking nor disliking something. Examples and warm-up questions (included in the Appendix) were provided to ensure participants understood the scale prior to rating samples. These warm-up questions were briefly examined before sensory testing began. Panelists were encouraged to refer back to the personalized scale when tasting samples.

The questionnaire was the same for all studies, though was presented electronically for young panelists and as a paper ballot for the older group. The only demographics collected were age and gender. The attributes of overall liking, appearance, mouthfeel, and flavor were evaluated for each sample using the hedonic gLMS. The characteristics of these attributes were described to participants. After rating attributes, panelists were asked to identify the food in the sample. If the exact identity was unknown, panelists were to identify the food group (i.e. vegetable, meat, grain).

Study 1: Shaped Purées

The young cohort was made up of 97 panelists, 55 female and 42 male, ranging from 18-33 years of age with a median age of 23. The elder cohort included 70 panelists, 59 female and 11 males, with an age range of 60-89 and median age of 73. The shaped purées in this study are commercially produced by Hormel Health Labs (Austin, MN) and include: Thick & Easy® Puréed Shaped Chicken, Roast Pork, Broccoli, and Green Beans. A total of eight samples were presented to panelists during one session, with the shaped and unshaped version of each of the foods.

Samples were taken out of the freezer and put into refrigeration 48 hours prior to the panel. The samples were removed from refrigeration 2-3 hours before the panel began in order to come to room temperature (within 19-25°C). Half of the shaped purées were taken out of the molds and placed onto plates. The remaining half were placed into a sheet pan and blended until the mixture resembled a standard puréed food. The unshaped purées were placed into 4-ounce plastic cups with an ivory #10 scoop to achieve volume comparable to the shaped purées. The samples in this study were selected to provide two very different food groups but each with foods of similar color. This was done to reduce the chance of guessing correctly as a result of remembering a previous sample.

Study 2: Combination versus Individual Purées

This study was made up of two sections, combination purées and individual purées. In section one, young panelists were comprised of 103 persons, 46 male and 57 female, with an age range of 18-32 and median age of 23 years. Elder persons included 67 panelists, 53 female and 13 male, ranging in age 60-89 with median age 72 years. In section two, the young group consisted of 77 panelists, 34 males and 43

females with age range 18-32 and median age 23 years. In the elder group, there were 58 panelists, 48 female and 10 male ranging in age from 60-88 with a median age of 72 years.

The combination puréed foods were two samples made up of three foods, including Hormel Health Lab's (Austin, MN) Thick & Easy® Purée Roasted Chicken with Potatoes and Carrots, and Thick & Easy® Home-style Beef with Potatoes and Corn. Purées were distributed using a blue #16 scoop into 4-ounce plastic cups. The individual purées correspond to the three foods present in the combination purées, except that each food was presented as an individual food across six samples. These samples include Campbell's *garden*purée® (Toronto, Canada) Creamy Corn and Sweet Carrots, Campbell's (St. Louis, MO) Thick-It Salisbury Steak Purée and Chicken à la King Purée, and Publix (Lakeland, FL) Instant Potatoes (prepared according to package directions with Publix 2% milk, Publix margarine, Publix iodized salt). Puréed foods were distributed using a red #24 scoop into 4-ounce plastic cups. A smaller scoop size was used for individual purées due to a limited supply of product.

The combination purées and individual protein purées were shelf stable and thus did not require further preparation. The individual corn and carrot purées came frozen and were thawed under refrigeration 48 hours in advance to the panel and then brought to room temperature (within 19-25°C) approximately three hours before the beginning of the panel. The individual puréed potatoes were prepared the night before the panel and kept under refrigeration until the next morning and then brought to room temperature.

Section one comprised combination purées which were evaluated first. These purées were presented prior to the individual purées to reduce the chance of food recall.

Combination purées were randomized within each test group (up to 10 for young persons and up to 20 for elder persons) within each session. The six individual purées in section two were presented on two trays with three samples each. The two trays consisted of the three foods that corresponded to the combination purée. Namely, one tray was made up of chicken, carrots, and potatoes, corresponding to the combination purée composed of the same three foods. Placement on the tray was fixed for each panelist but the two trays were randomized within each session similarly to the combination purées.

In section one, panelists were asked to identify three foods present in the combination purée. In section two, panelists were asked to identify the three foods individually. Panelists were not given any indication that these samples contained the same foods.

Study 3: Regular Sodium versus Reduced Sodium Bread Purées

Panelists in the young cohort were made up of 97 persons, 42 male and 55 female ranging from 19-33 years of age with a median age of 23 years. In the elder group there were 70 panelists, 55 female and 14 male with an age range of 60-88 and median age of 73 years. A comparison of regular sodium and reduced sodium products was done with a bread purée prepared from Darlington Farms Purée Bread & Bakery Mix (Noblesville, IN), Publix canola oil, and deionized water. Two samples were prepared, one with sodium content comparable to an average slice of bread and the other with 50% reduced sodium content.

To make the reduced sodium sample, the bread purée was prepared according to package directions with only the addition of oil and water, as the bread mix alone had only 65 mg sodium and thus, could be considered a lower sodium bread product. In

order to have a 50% reduced sodium product, the higher sodium food required 130 mg sodium, comparable to an average slice of bread. For the regular sodium bread purée, iodized salt was added at the appropriate concentration to achieve 130 mg sodium content per serving. According to the package, one serving of the bread purée is served with a red #24 scoop to achieve approximately a 1 ounce serving, equivalent to a slice of bread. This same scoop was used to distribute samples into 4-ounce plastic cups. As with the other studies, panelists were asked to rate attributes of overall liking, appearance, mouthfeel, and flavor. Panelists were also asked to identify the food or food group of the bread purées.

Study 4: Conventional Purées

Only elder panelists participated in Study 4, primarily as a preliminary investigation into the use of conventional puréed foods. The group consisted of 60 panelists, 48 female and 12 male, ranging in age from 60-88 with a median age of 72. The samples included three bean foods as well as a dessert-like item, selected both for nutritional content and acceptance by the general population. The foods used were Publix deli-style classic hummus (Lakeland, FL), Old el Paso traditional refried beans (Victoria, Australia), Bush's vegetarian baked beans (Chestnut Hill, TN), and Farmer's Market organic pumpkin pie mix (Corvallis, OR). All samples were already in purée form, with the exception of baked beans which were placed into a food processor and completely homogenized. Samples were distributed into 4-ounce plastic cups using a red #24 scoop. As with other studies, panelists were asked to rate attributes and identify the food or food group.

Statistical Analysis

The primary objective of this study was to evaluate acceptability ratings for various attributes across samples and to determine identification accuracy between age groups. Raw data for acceptability ratings among young adults was entered electronically and collected using the software program CompuSense®. Data were analyzed using the program SAS 9.2 (SAS Institute Inc. Cary NC, USA). For each study, analysis of variance (ANOVA) with Duncan's multiple range test was carried out to determine significance at $p < 0.05$ for each attribute across all samples.

In Study 1, ANOVA was conducted across the eight unshaped and shaped samples for each attribute. In Study 2, Part 1, ANOVA was carried out across the two combination samples for each attribute. In Study 2, Part 2, ANOVA was conducted across each of the six individual samples for each attribute. In order to compare across Part 1 and 2 for Study 2, means from the individual purées in Part 2 were averaged for each meal type (the chicken or beef meal), thus condensing six samples into two. These averages were then compared with the means of the combination chicken meal and combination beef meal samples via ANOVA for every attribute. For Study 3, each attribute was evaluated using ANOVA across the two bread purée samples. In Study 4, ANOVA was carried out across four samples for each attribute. Data were also sorted based on the two age groups within Studies 1-3, where no additional sorting was needed for Study 4.

Identification accuracy was analyzed by percentages. All identifications were entered as a free-form response by panelists. For Studies 1, 3, and 4, panelists were asked to identify the exact food and instructed to enter the food group or make an educated guess if the exact food could not be identified. During training, food group

descriptions were briefly explained. For Study 2, identifications were classified based on the number of foods correctly identified. Since there were three foods present in both session 1 and 2, identifications were categorized as 0, 1, 2, or 3 correct foods. Because classifying the degree of correctness in a response is rather subjective, the guidelines that were used are included below in Tables 3-1 through 3-4. Each table represents the standard used to categorize panelist responses.

Once responses were classified into each identification category, these scores and overall acceptability ratings for each sample were compared by use of Spearman correlation coefficients. Overall likability was analyzed using the VAS ranging from -100 to 100 while identification of the pureed food fell into one of several possible categories depending on the study. For studies 1 and 4, identifications were categorized as 1= correct food, 2= correct food group, and 3= incorrect. For study 2, there were four possible categories: [1= 1 correct food, 2= 2 correct foods, 3= 3 correct foods, 4= incorrect]. For Study 3, identifications were classified as either 1= correct food/food group or 2= incorrect. These category assignments were compared to overall acceptability ratings to examine the relationship between acceptability scores and identification accuracy.

Table 3-1. List of identification categories for study 1: shaped purées

Food	Correct Food	Correct Food Group	Incorrect Food or Food Group
Broccoli	Broccoli	Any vegetable, excluding potatoes/beans	Any other food choice or comment
Green beans	Green beans	Any vegetable, excluding potatoes/beans	Any other food choice or comment
Chicken	Poultry product – chicken or turkey	Any fish, beef, or pork item	Any other food choice or comment
Pork	Pork and general pork processed foods (hot dog, ham, bacon, sausage, pepperoni)	Any fish, beef, or poultry item	Any other food choice or comment

Table 3-2. List of identification categories for study 2: combination vs. individual purées

Food	Correct Food	Incorrect Food
Chicken	Poultry product (chicken/turkey)	Any other food choice or comment
Carrot	Carrot	Any other food choice or comment
Beef	Any beef/meat product	Any other food choice or comment
Corn	Corn	Any other food choice or comment
Potato	Potato	Any other food choice or comment

Table 3-3. List of identification categories for study 3: regular sodium vs. reduced sodium bread purées

Food	Correct Food/Food Group	Incorrect Food or Food Group
Bread	Any grain product (e.g. bread cereal, pasta, rice)	Any other food item or comment

Table 3-4. List of identification categories for study 4: conventional purées

Food	Correct Food	Correct Food Group	Incorrect Food or Food Group
Baked Beans	Baked beans or beans	Vegetable or starch	Any other food item or comment
Refried beans	Refried beans or beans	Vegetable or starch	Any other food item or comment
Hummus	Hummus or beans	Vegetable or starch	Any other food item or comment
Pumpkin	Pumpkin or sweet potato	Vegetable	Any other food item or comment

CHAPTER 4
RESULTS

Study 1: Shaped Purées

All young persons were included in the analysis. Eleven persons in the elder group were excluded from data analysis due to misuse of the scale in rating samples. Tables 4-1 and 4-2 indicate acceptability ratings of young and older panelists of shaped and unshaped purées. Unshaped purées generally received higher acceptability ratings over shaped purées. Figure 4-1 illustrates the differences in acceptability ratings between age groups. Overall, these differences were not significant, signifying age as unrelated to shaping of puréed foods. Figures 4-2 through 4-5 portray identification accuracy of each sample by both age groups. Shaping did not improve identification and in fact, some unshaped purées had greater correct identifications than the shaped counterpart. Generally, young persons were better at identifying the correct food while older persons were more likely to identify only the food group.

Study 2: Combination versus Individual Purées

Only panelists who participated in both sessions were included in data analysis. As a result, data for 73 young persons and 51 elder persons were evaluated. Figure 4-6 compares the two combination meals for each age group, with beef purées significantly less liked for all attributes with young persons and flavor for older adults. Figures 4-7 and 4-8 demonstrate acceptance of individual purées for each age group, with the potato purée receiving the highest ratings for every attribute within both the beef and chicken meals for both age groups. In order to evaluate the relationship of individual with combination puréed foods, an average of acceptability ratings for the three individual purées was calculated to create one value that could be compared. When

ratings of combination and individual foods was compared across age groups (Figures 4-9 and 4-10), it is clear that older adults rated individual purées quite differently than young persons while both groups rated combination purées similarly. Older adults tended to give higher ratings for individual puréed food samples. In Figure 4-11, acceptability ratings of combination purées are compared to individual purées. In general, individual purées were given much higher acceptability ratings than the combination counterpart for the same meal type. Figures 4-12 and 4-13 illustrate identification accuracy for the beef and chicken meals, both when presented combined and individually. More foods were correctly identified when puréed samples were presented individually for both age groups, as expected.

Study 3: Regular Sodium versus Low-Sodium Bread Purées

All young and elder panelists were included in the analysis. Figure 4-14 demonstrates the comparison of acceptability ratings between regular sodium and reduced sodium bread purées for both age groups. There were no significant differences between the samples for any attribute. Figure 4-15 portrays the relationship of age on acceptability ratings of the bread purée samples. It is apparent the older adults rated both the regular sodium and reduced sodium bread purées higher than the young adults, indicating a greater liking for this product. In Figure 4-16, identification accuracy is portrayed, with very few differences between bread purée samples. In general, most panelists were able to identify the food or food group of this sample, with young panelists slightly better at identifications than older panelists.

Study 4: Conventional Purées

Only elder persons participated in this study and all panelists were included in analysis. Figure 4-17 illustrates acceptability ratings of the four conventional puréed

food samples, with pumpkin receiving the highest ratings for every attribute versus hummus which scored the lowest ratings for every attribute. Baked beans and refried beans were similarly liked across all attributes. Figure 4-18 conveys accuracy of identifications for conventional puréed foods. A large number of panelists were able to correctly identify pumpkin, refried beans, and baked beans. Hummus had the lowest identification accuracy, though this was expected with a rather exotic food product.

Acceptability Ratings and Identification Accuracy

Comparison of acceptability ratings and identification accuracy are highlighted in Table 4-3 and 4-4. Student comparisons of identification and overall likeability were significantly correlated at p-value < 0.05 with the following samples: shaped broccoli (p=0.046, r=0.203), shaped green beans (p=0.010, r=0.261), and regular bread (p=0.030, r=0.220). Elderly comparisons of ID and overall likeability were significantly correlated at p-value < 0.05 with the following samples: shaped green beans (p= 0.015, r=-0.315), unshaped green beans (p= 0.0107, r= 0.3298), unshaped pork (p= 0.021, r=-0.299), and baked beans (p=0.011, r=-0.317).

Table 4-1. Sample ratings by young adults for specific attributes of shaped vs. unshaped purées

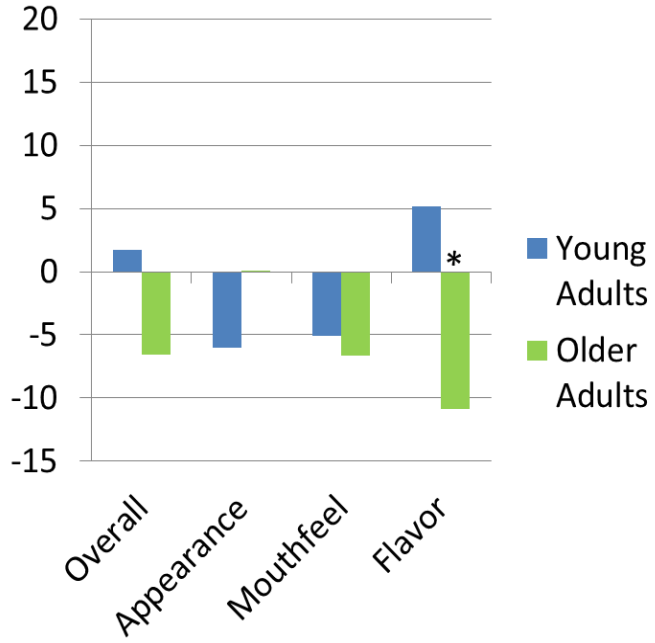
Sample	Overall Liking	Appearance	Mouthfeel	Flavor
Unshaped Chicken	5.2a	3.0a	-5.2ab	5.6a
Shaped Chicken	1.7a	-6.1bc	-5.1ab	5.2a
Unshaped Pork	3.2a	-2.9b	-2.4a	4.6a
Shaped Pork	1.5a	-9.7cd	-3.3a	5.7a
Unshaped Broccoli	2.4a	-5.1bc	1.5a	2.7a
Shaped Broccoli	-0.43ab	-6.3bc	-1.5a	-1.6ab
Unshaped Green beans	-0.90ab	-2.7b	-2.5a	0.83ab
Shaped Green beans	-5.8b	-14d	-10b	-5.9b

Note: Ratings were analyzed according to attribute. Ratings with the same letter within a specific attribute (column) are not significantly different at $p < 0.05$

Table 4-2. Sample ratings by older adults for specific attributes of shaped vs. unshaped purées

Sample	Overall Liking	Appearance	Mouthfeel	Flavor
Unshaped Chicken	8.3a	15a	6.1abc	14a
Shaped Chicken	-6.6a	0.03b	-6.6c	-11c
Unshaped Pork	2.8a	9.5ab	9.5ab	3.8abc
Shaped Pork	-6.7a	-0.06b	-7.7c	-5.9bc
Unshaped Broccoli	3.2a	3.7ab	18a	7.6ab
Shaped Broccoli	1.3a	1.0b	15a	3.9abc
Unshaped Green beans	-1.2a	4.8ab	12a	0.98abc
Shaped Green beans	-8.7a	-2.0b	-3.3bc	-6.1bc

Note: Ratings were analyzed according to attribute. Ratings with the same letter within a specific attribute (column) are not significantly different at $p < 0.05$



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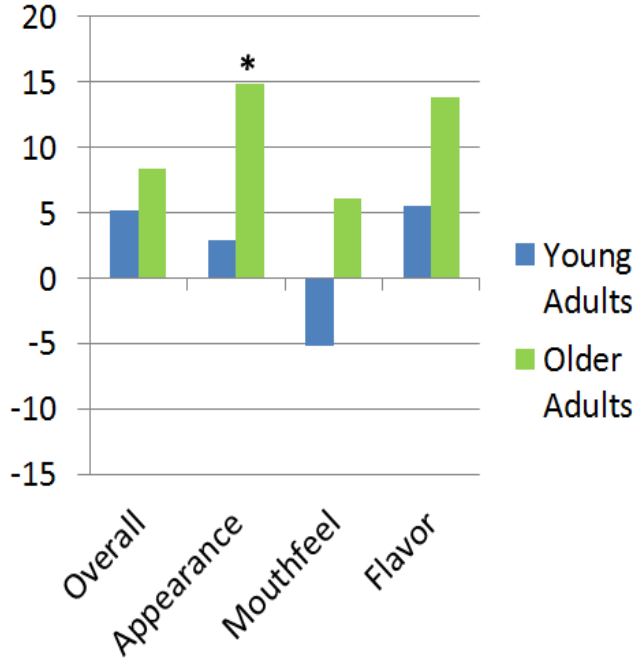

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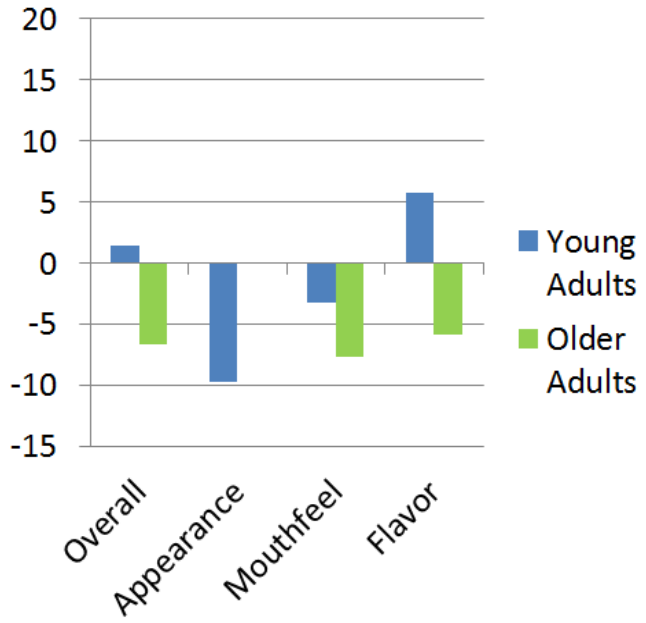
Figure 4-1. Effect of age on mean sample ratings of shaped and unshaped purées. A) Shaped chicken. B) Unshaped chicken. C) Shaped pork. D) Unshaped pork. E) Shaped broccoli. F) Unshaped broccoli. G) Shaped green beans. H) Unshaped green beans (Note: * indicates significance at $p < 0.05$)



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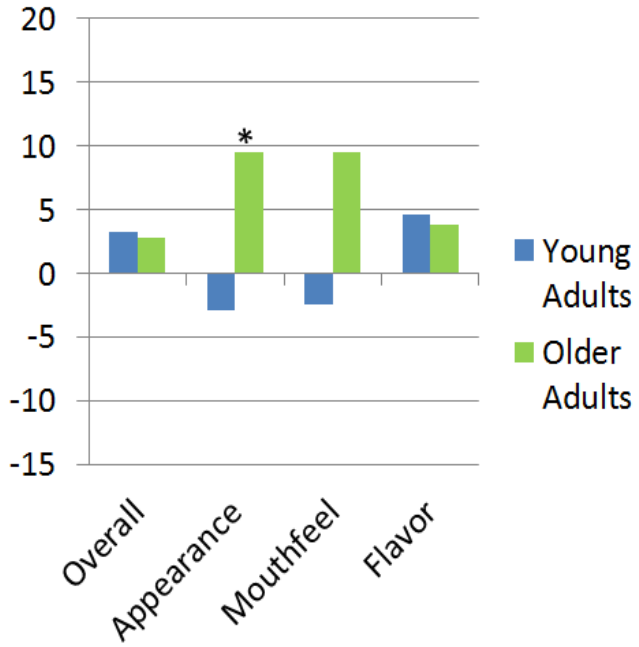

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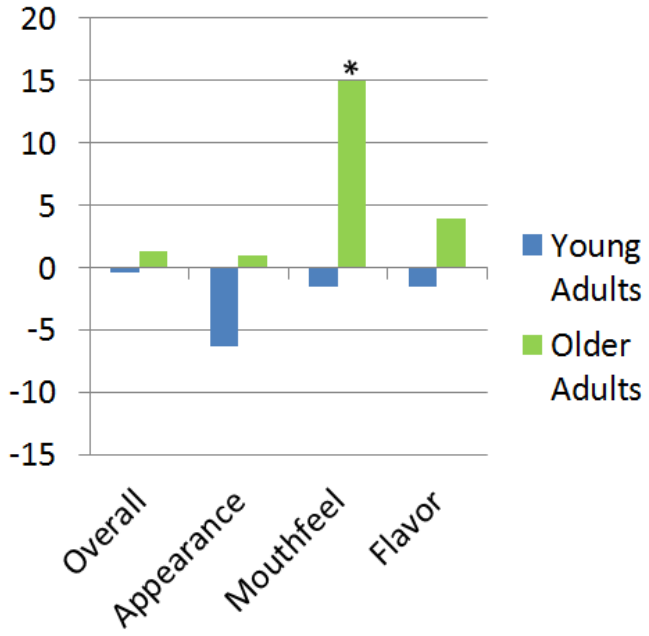
Figure 4-1. Continued



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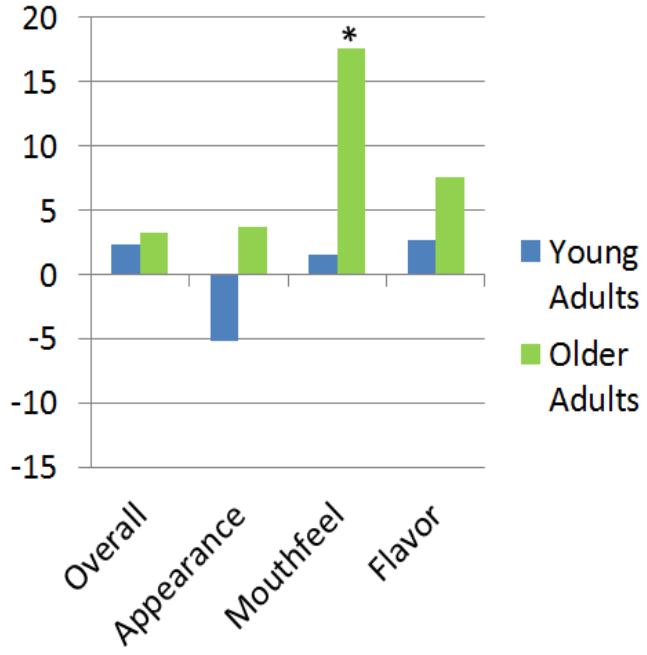

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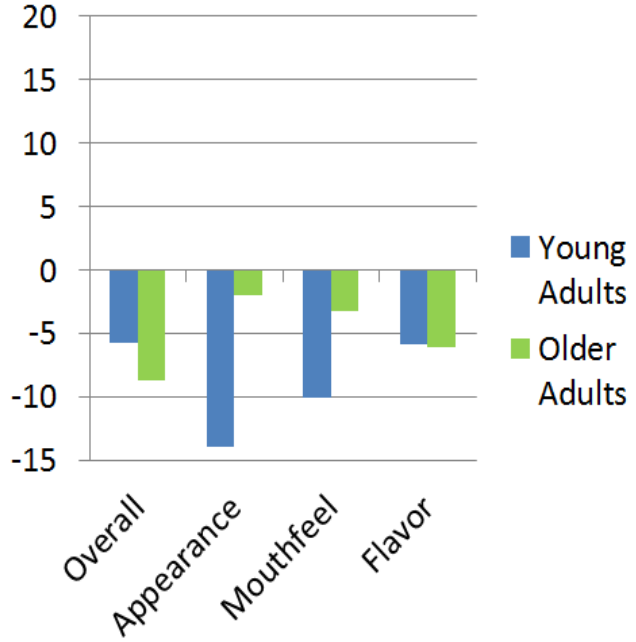
Figure 4-1. Continued



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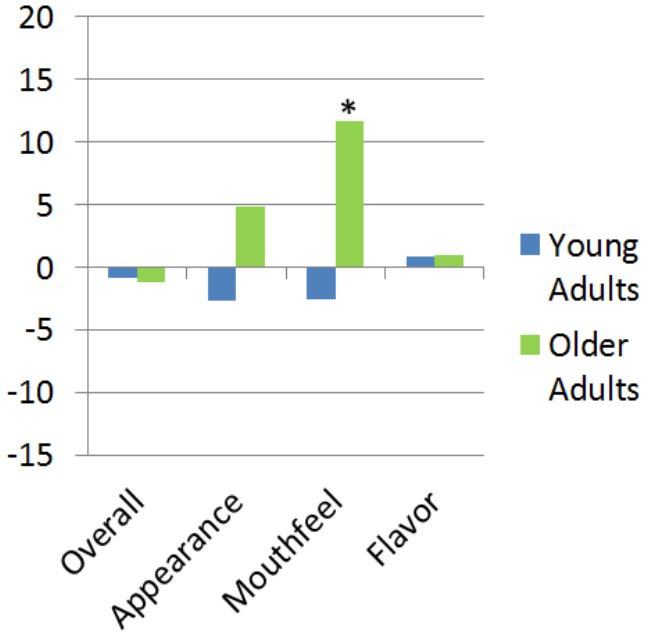

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Figure 4-1. Continued

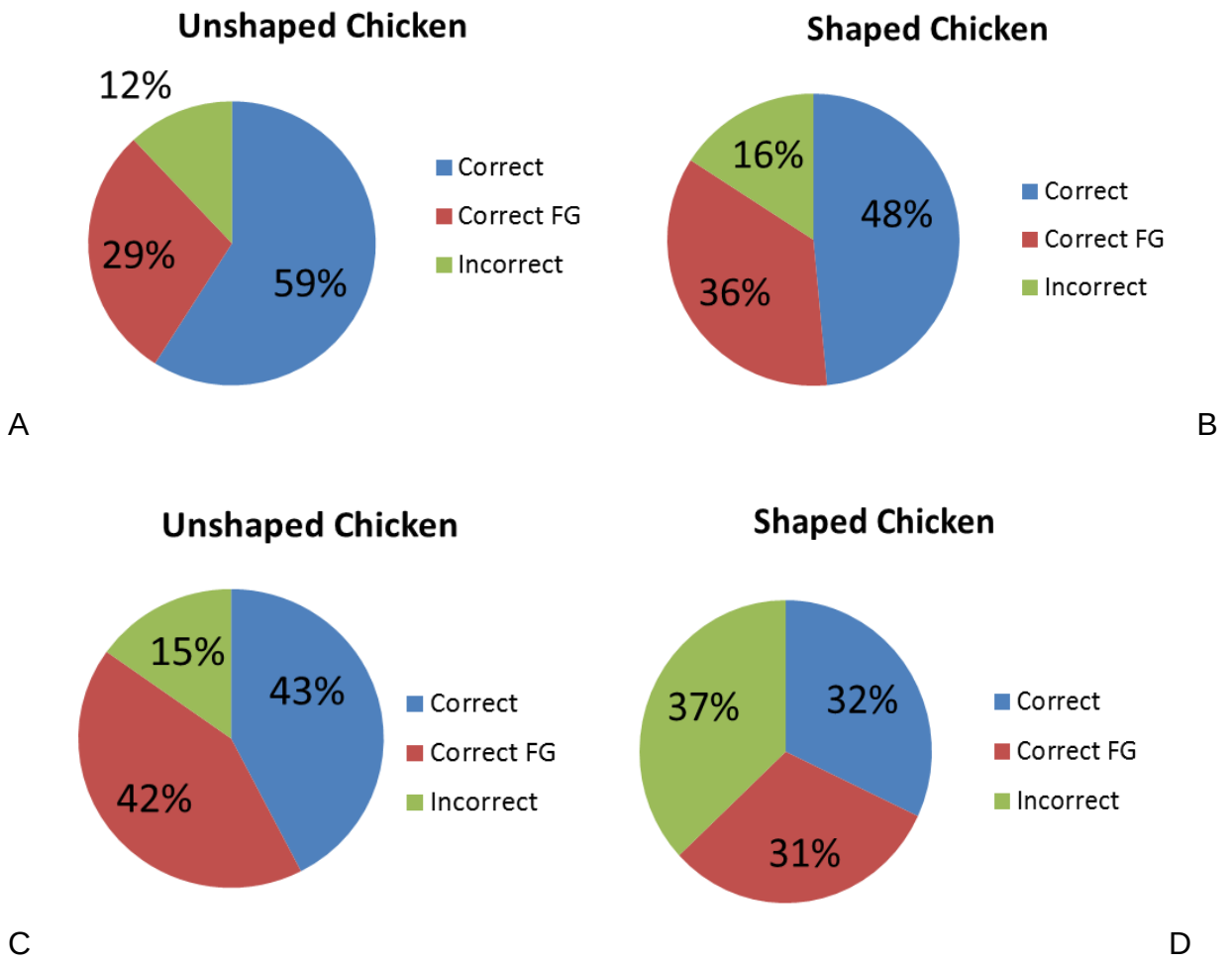


Figure 4-2. Identification accuracy of chicken purées. A) Unshaped chicken by young Adults. B) Shaped chicken by young adults. C) Unshaped chicken by older adults. D) Shaped chicken by older adults.

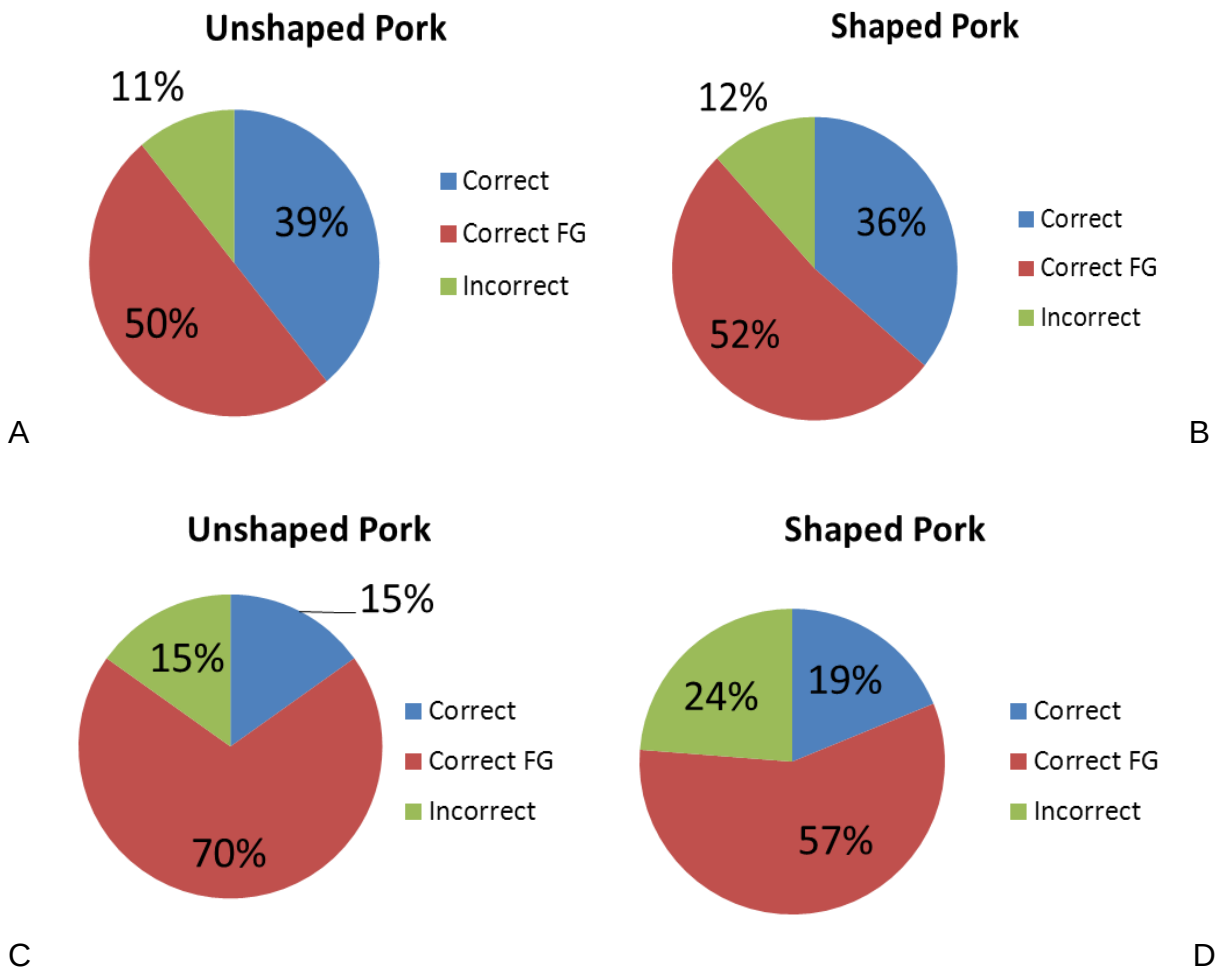


Figure 4-3. Identification accuracy of pork purées. A) Unshaped pork by young adults. B) Shaped pork by young adults. C) Unshaped pork by older adults. D) Shaped pork by older adults.

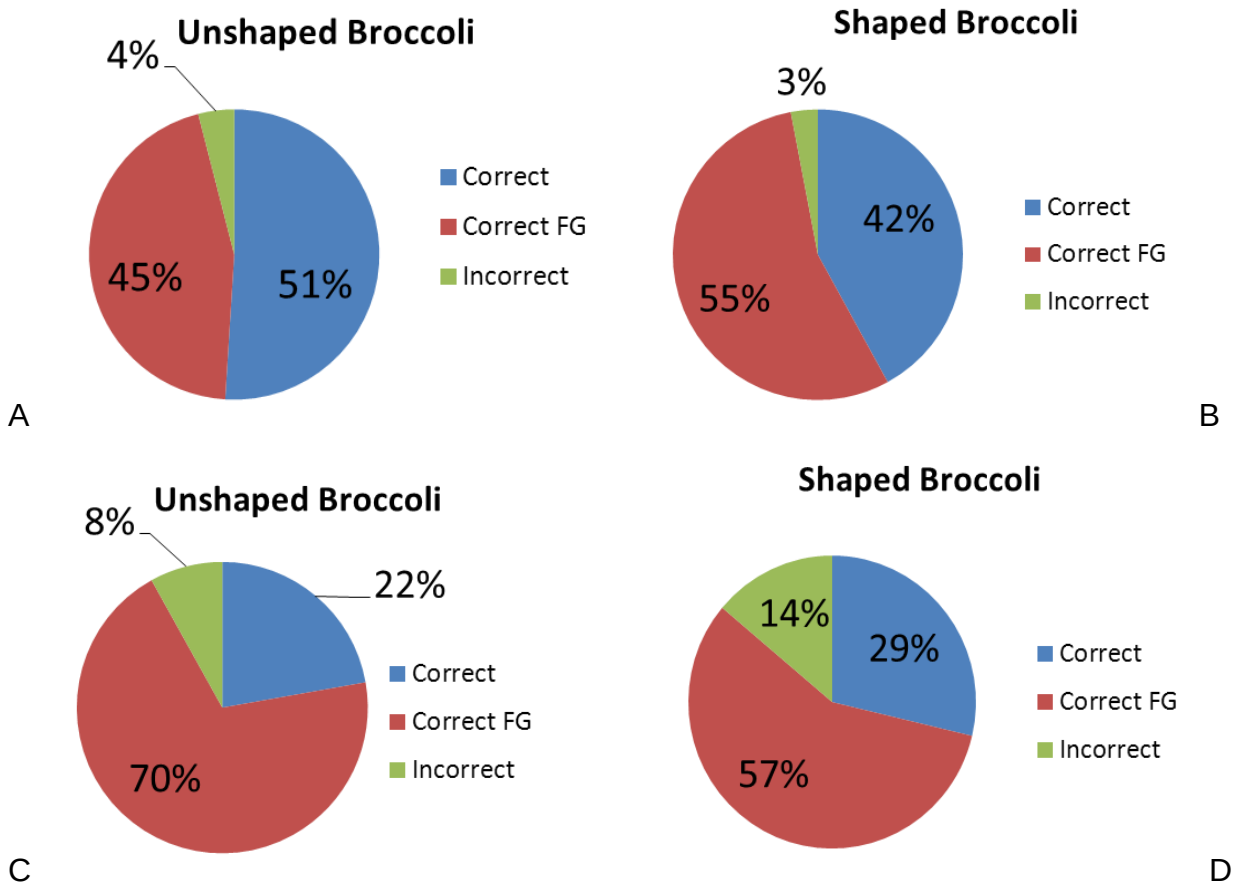


Figure 4-4. Identification accuracy of broccoli purées. A) Unshaped broccoli by young adults. B) Shaped broccoli by young adults. C) Unshaped broccoli by older adults. D) Shaped broccoli by older adults.

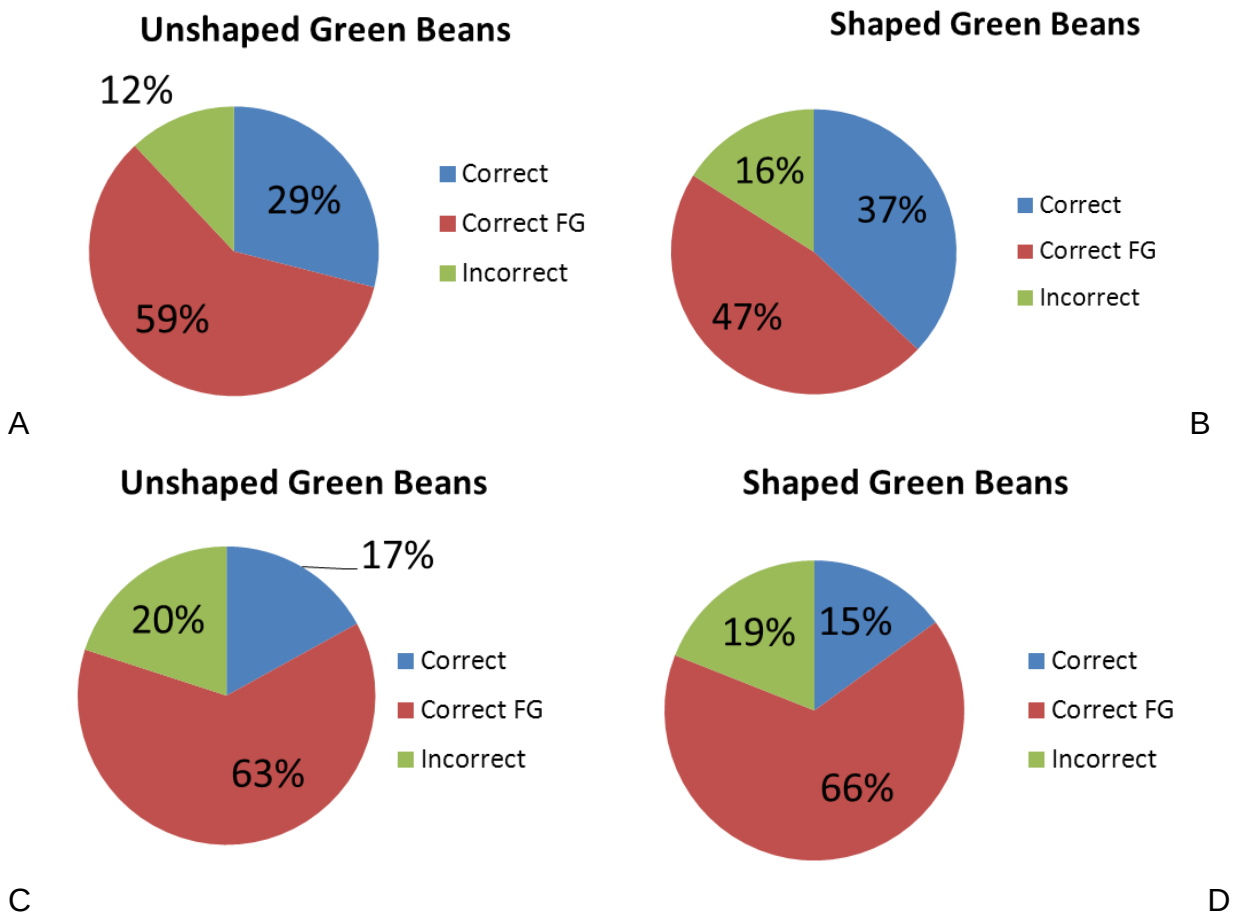
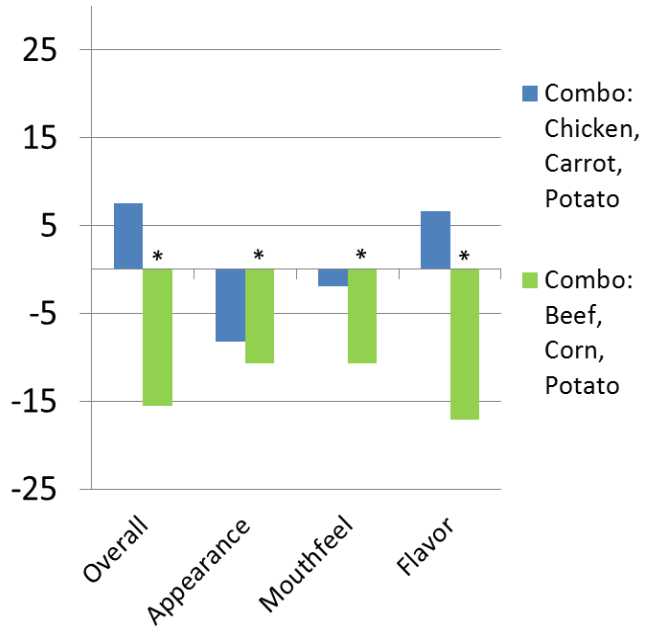


Figure 4-5. Identification accuracy of green bean purées. A) Unshaped green beans by young adults. B) Shaped green beans by young adults. C) Unshaped green beans by older adults. D) Shaped green beans by older adults.



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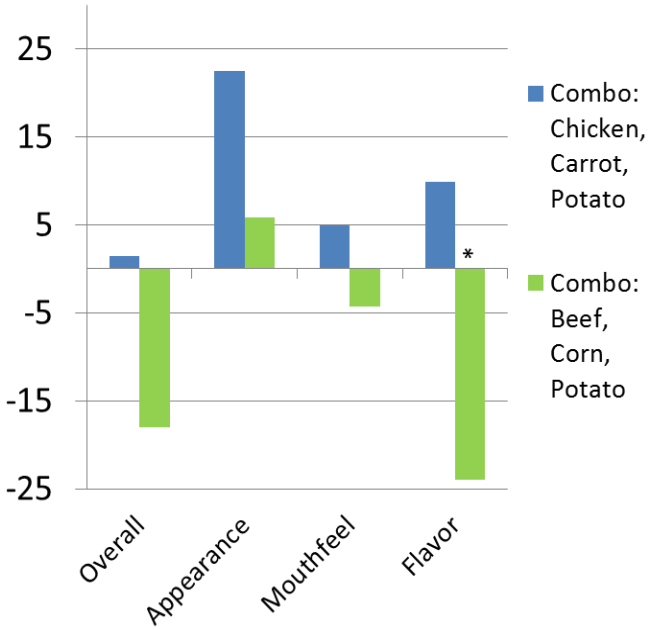

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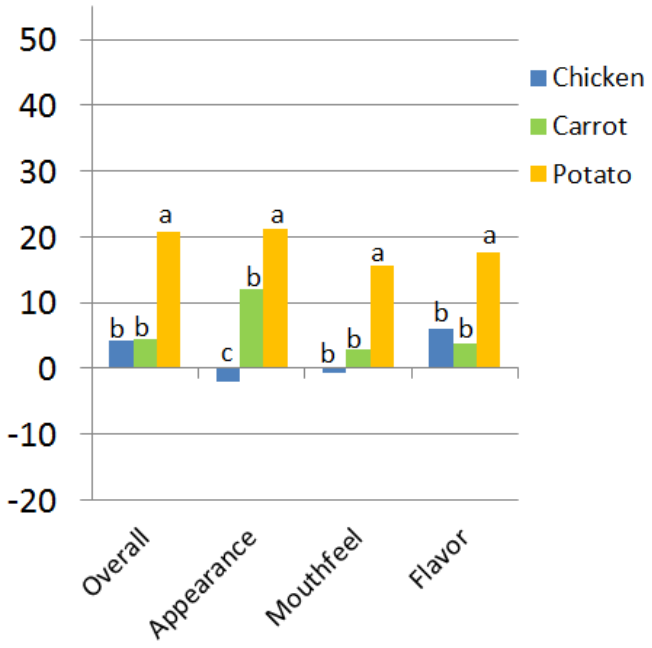
Figure 4-6. Sample ratings for specific attributes of combination purées for each age group. A) Young adults. B) Older adults (Note: * indicates significance at $p < 0.01$).



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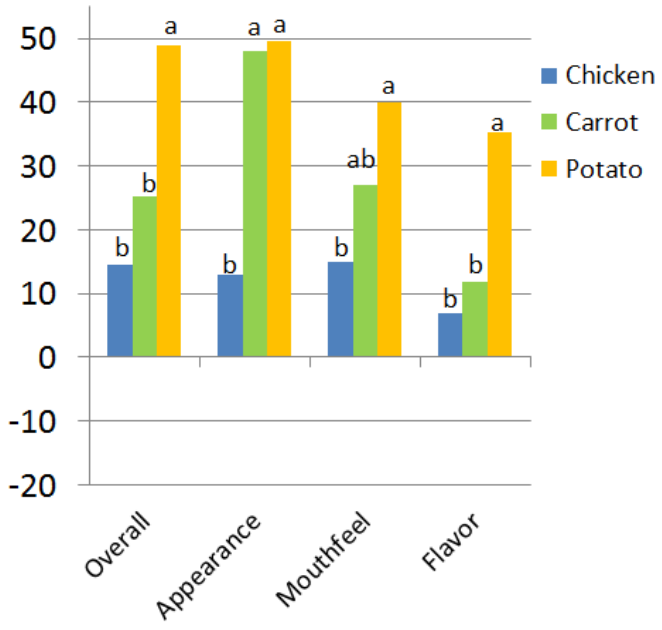
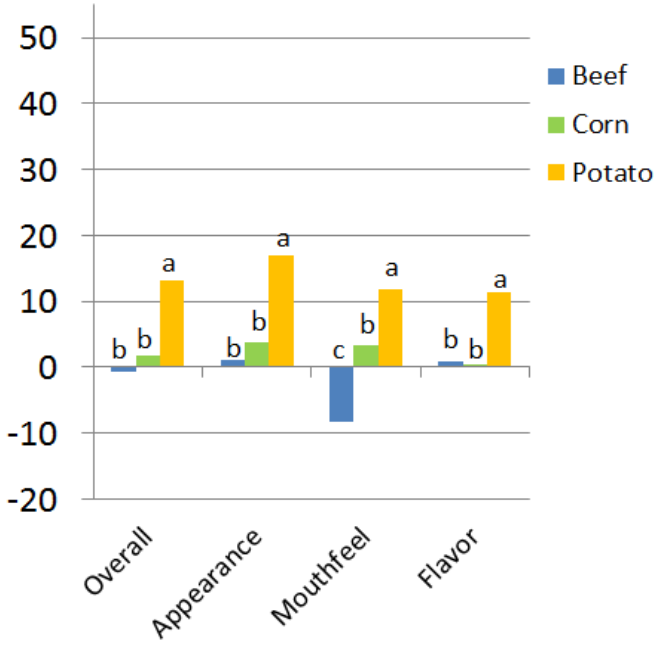


B

Figure 4-7. Sample ratings for specific attributes of individual chicken, carrot, and potato purées. A) Young adults. B) Older adults (Note: Ratings with different letters for a specific attribute indicate significance at $p < 0.01$).



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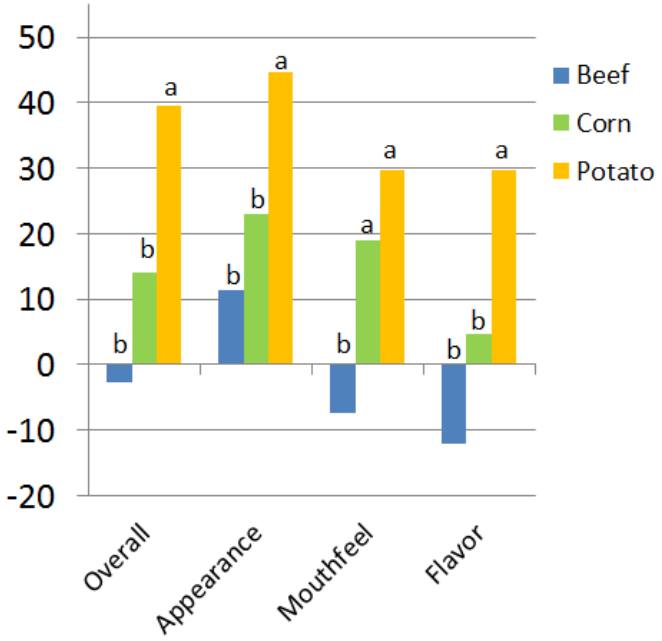
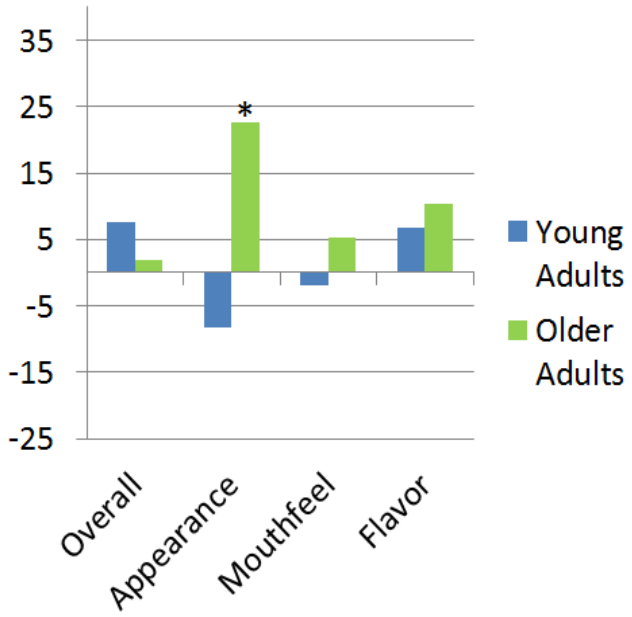


B

Figure 4-8. Sample ratings for specific attributes of individual beef, corn, and potato purées. A) Young adults. B) Older adults (Note: Ratings with different letters for a specific attribute indicate significance at $p < 0.01$).



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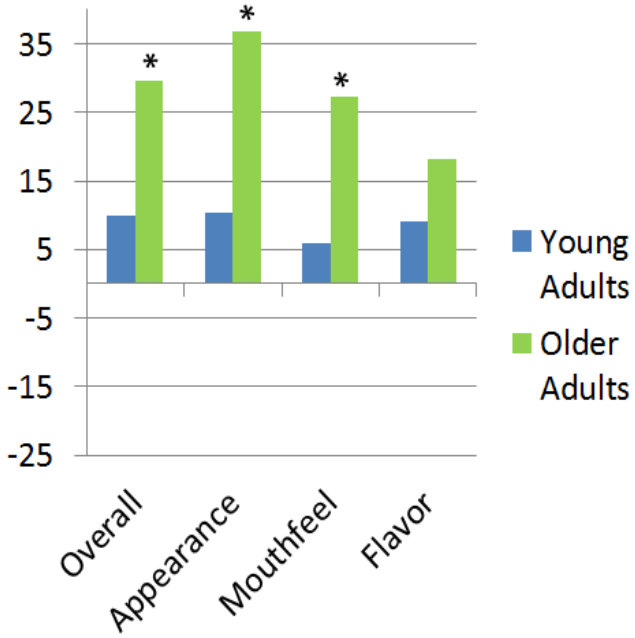
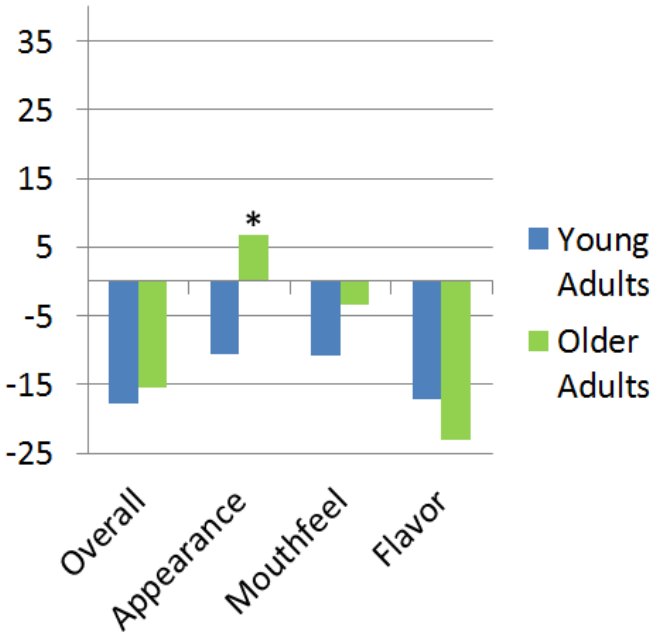


B

Figure 4-9. Effect of age on mean sample ratings of combination versus individual purée meals. A) Combination chicken, carrot, potato meal. B) Individual chicken, carrot, potato meal. (Note: * indicates significance at $p < 0.05$)



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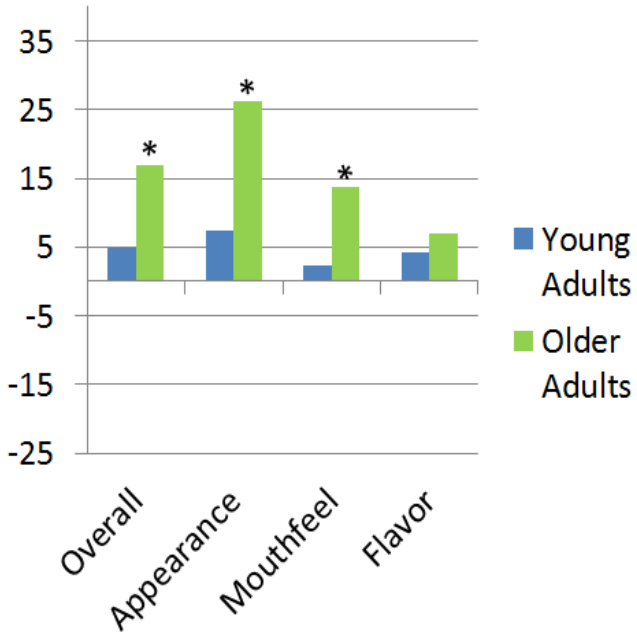
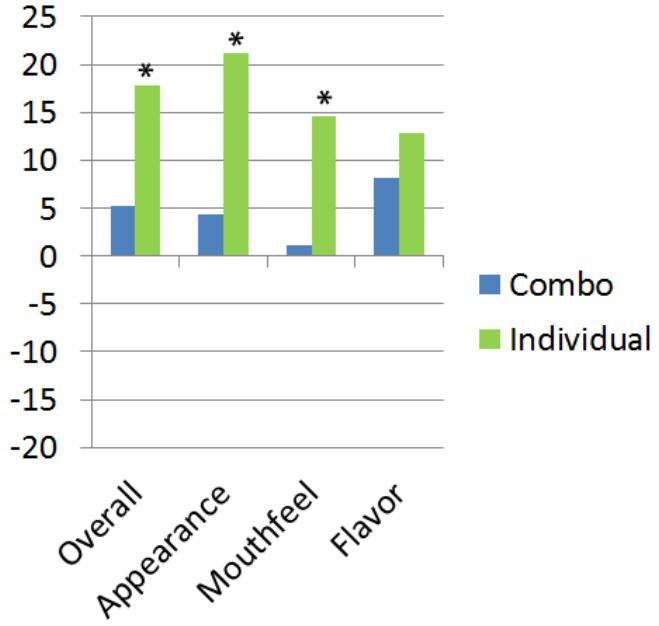


B

Figure 4-10. Effect of age on mean sample ratings of combination versus individual purée meals. A) Combination beef, corn, potato meal. B) Individual beef, corn, potato meal. (Note: * indicates significance at $p < 0.05$)



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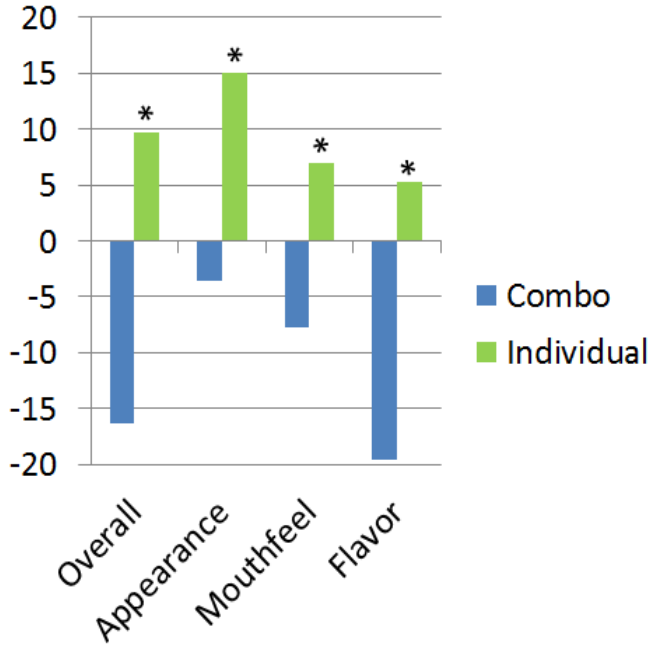


B

Figure 4-11. Mean sample ratings of combination versus indvidual purée meals. A) Chicken, carrot, potato purée. B) Beef, corn, potato purée. (Note: * indicates significance at $p < 0.05$).

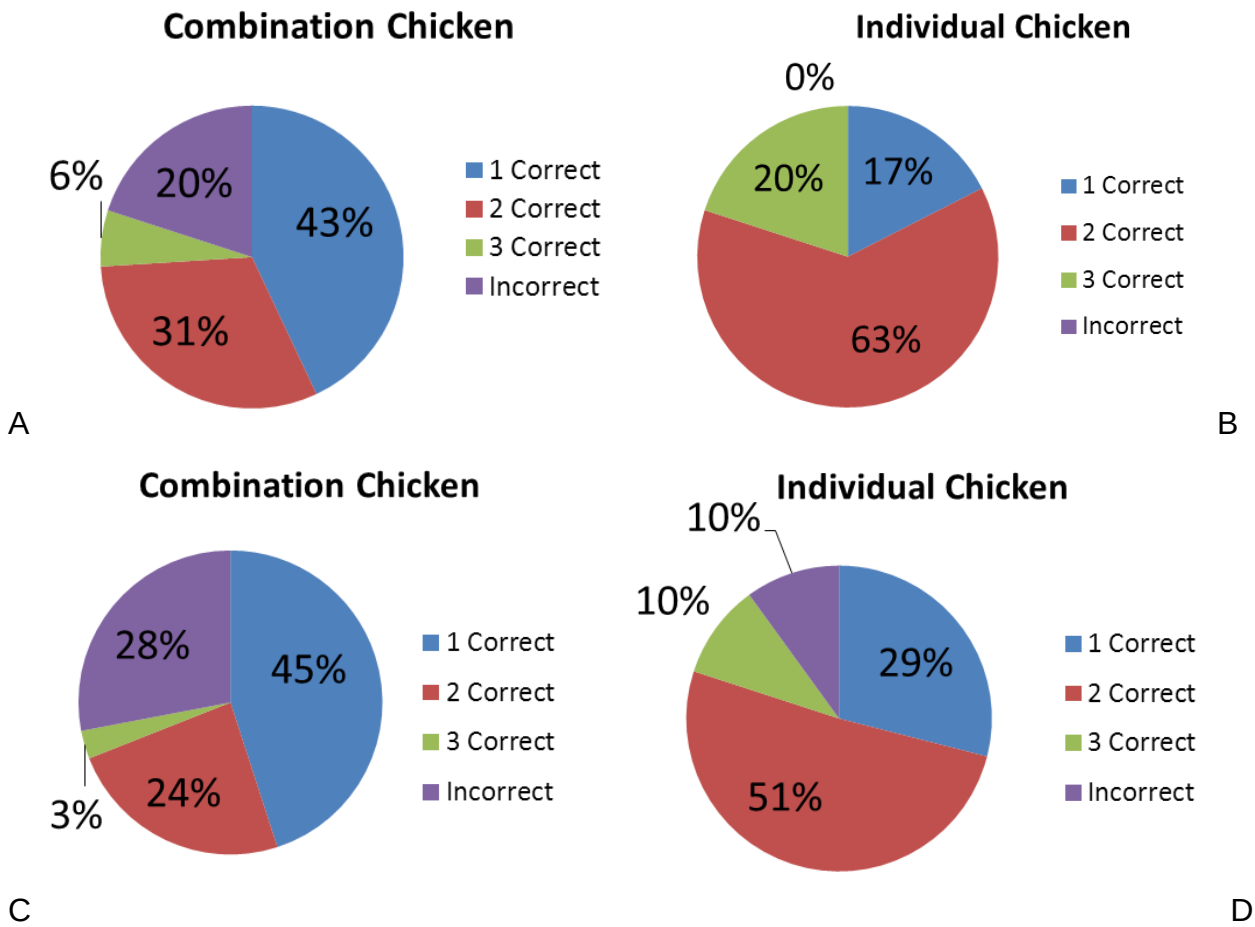


Figure 4-12. Identification accuracy of combination and individual chicken, carrot, potato meal purées A) Combination purées by young adults. B) Individual purées by young adults. C) Combination purées by older adults. D) Individual purées by older adults

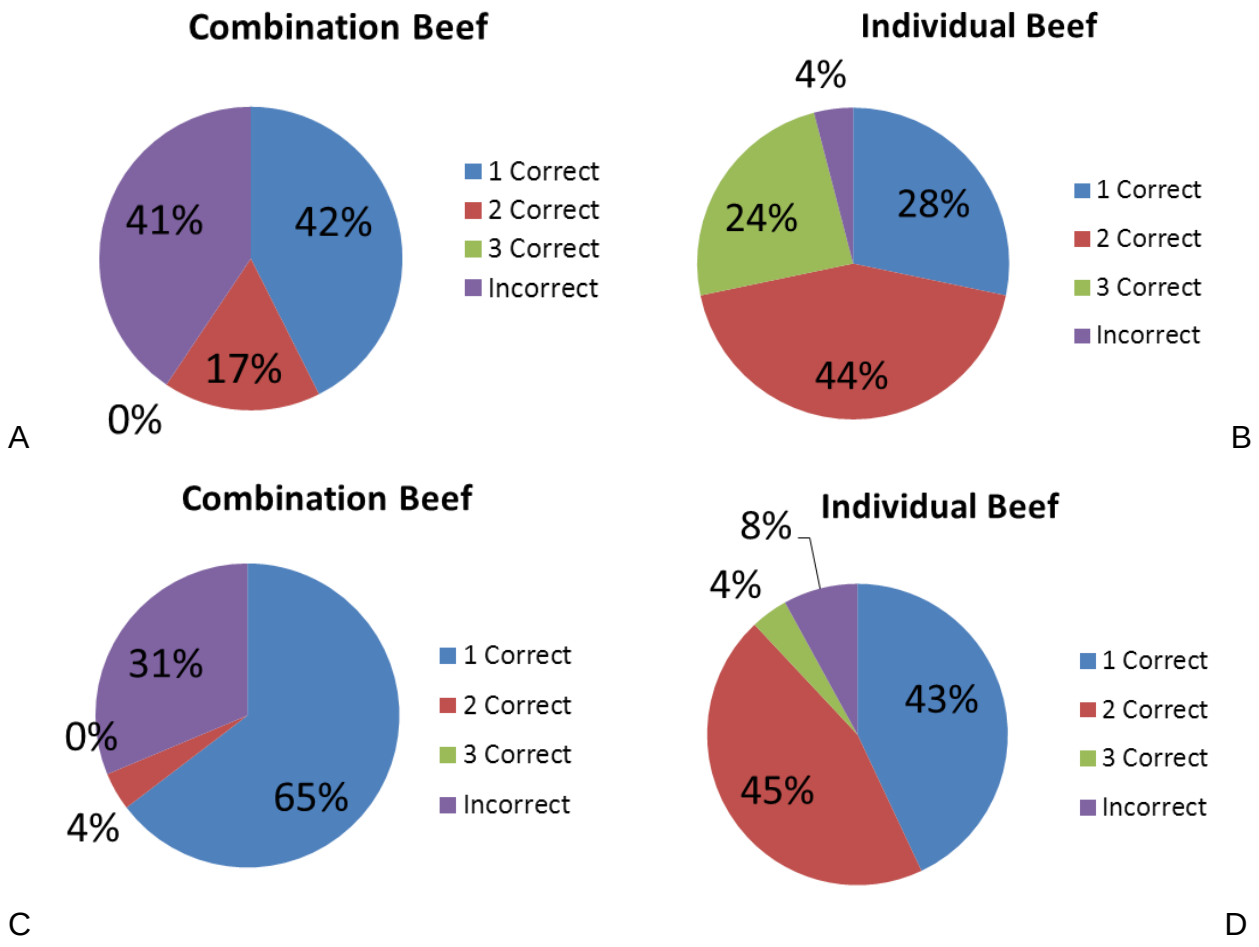
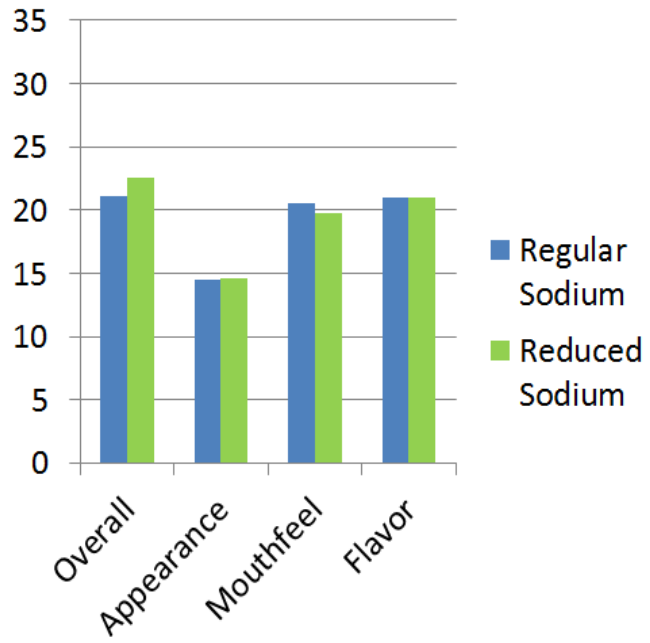
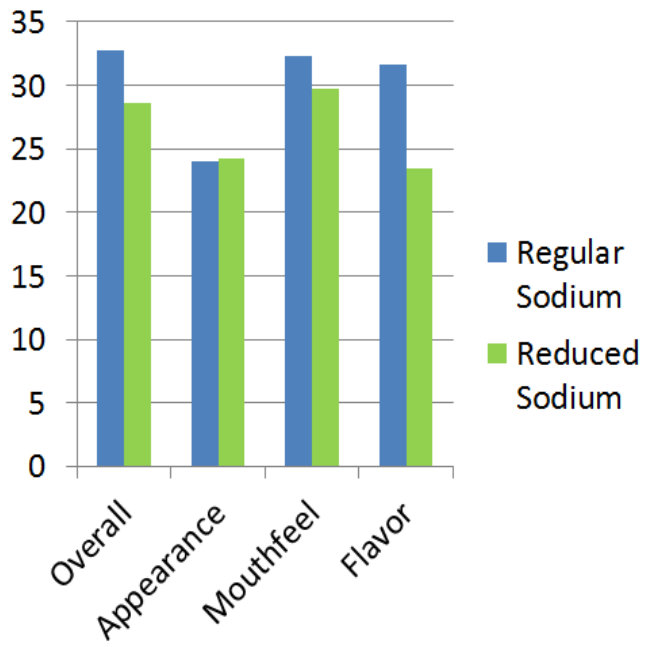


Figure 4-13. Identification accuracy of combination and individual beef, corn, potato meal purées A) Combination purées by young adults. B) Individual purées by young adults. C) Combination purées by older adults. D) Individual purées by older adults

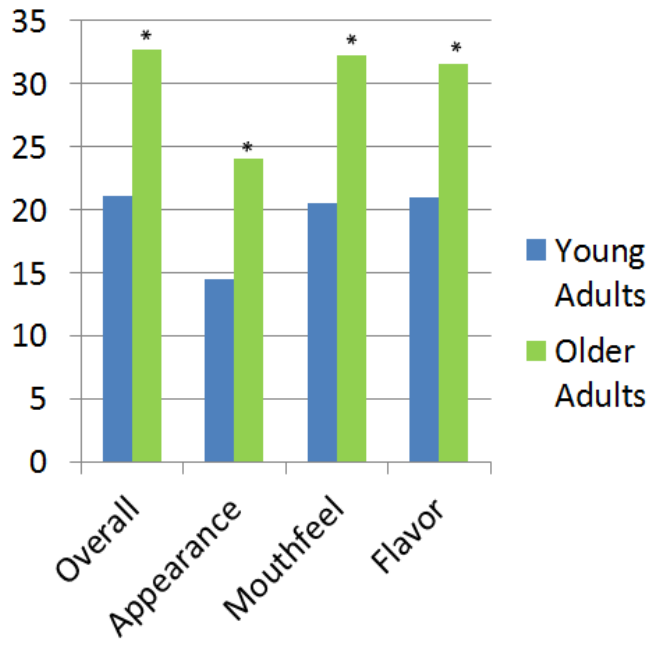


A

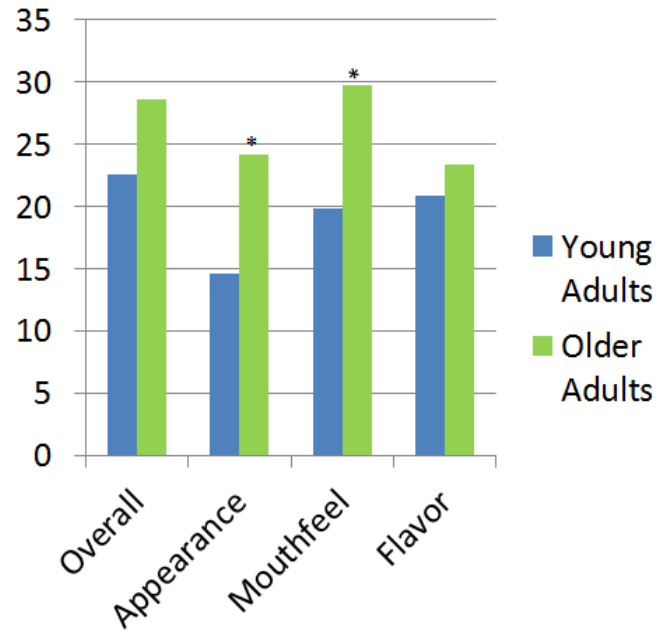


B

Figure 4-14. Sample ratings for specific attributes of regular sodium and reduced sodium bread purées. A) Young adults. B) Older adults. (Note: * indicates significance at $p < 0.05$)



A



B

Figure 4-15. Effect of age on mean sample ratings of regular sodium and reduced sodium bread purées. A) Regular sodium bread. B) Reduced sodium bread. (Note: * indicates significance at $p < 0.05$)

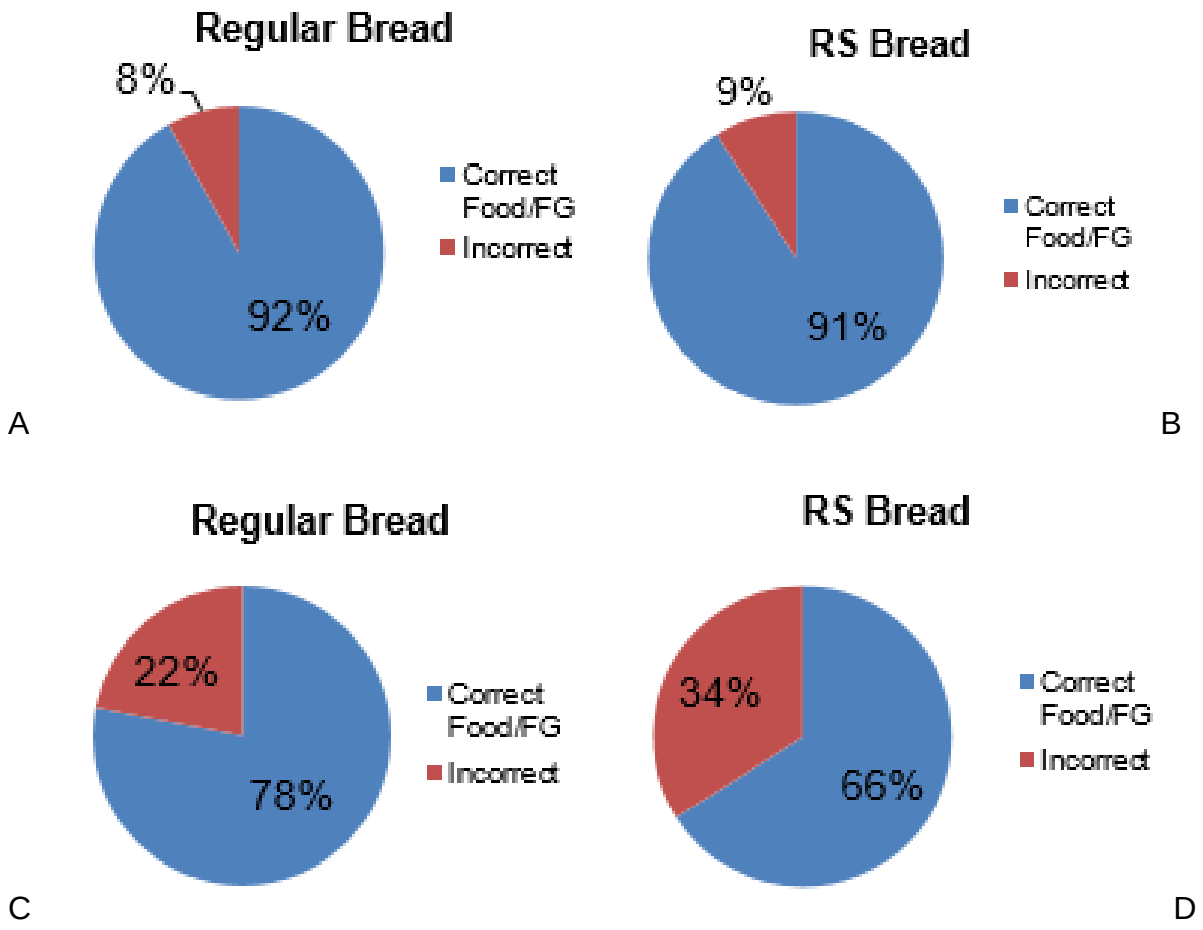


Figure 4-16. Identification accuracy of regular sodium and reduced sodium (RS) bread purées A) Regular sodium bread purées by young adults. B) Reduced sodium bread purées by young adults. C) Regular sodium bread purées by older adults. D) Reduced sodium bread purées by older adults

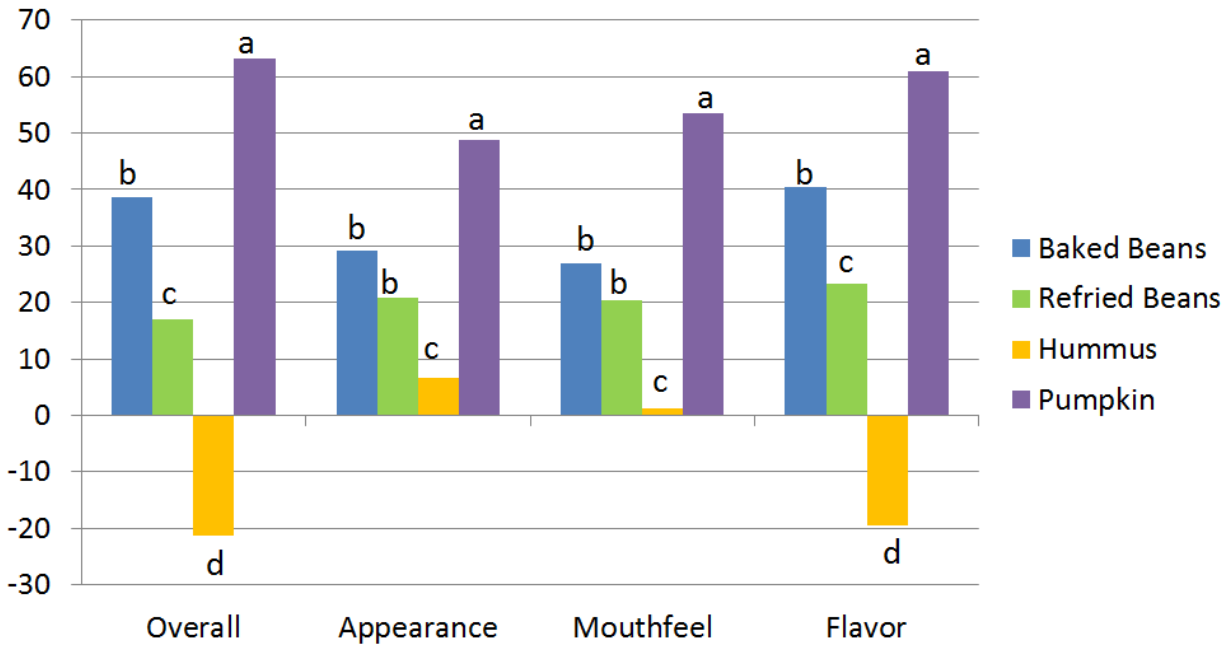


Figure 4-17. Sample ratings for specific attributes of conventional purées by older adults. (Note: Ratings with different letters for a specific attribute indicate significance at $p < 0.05$).

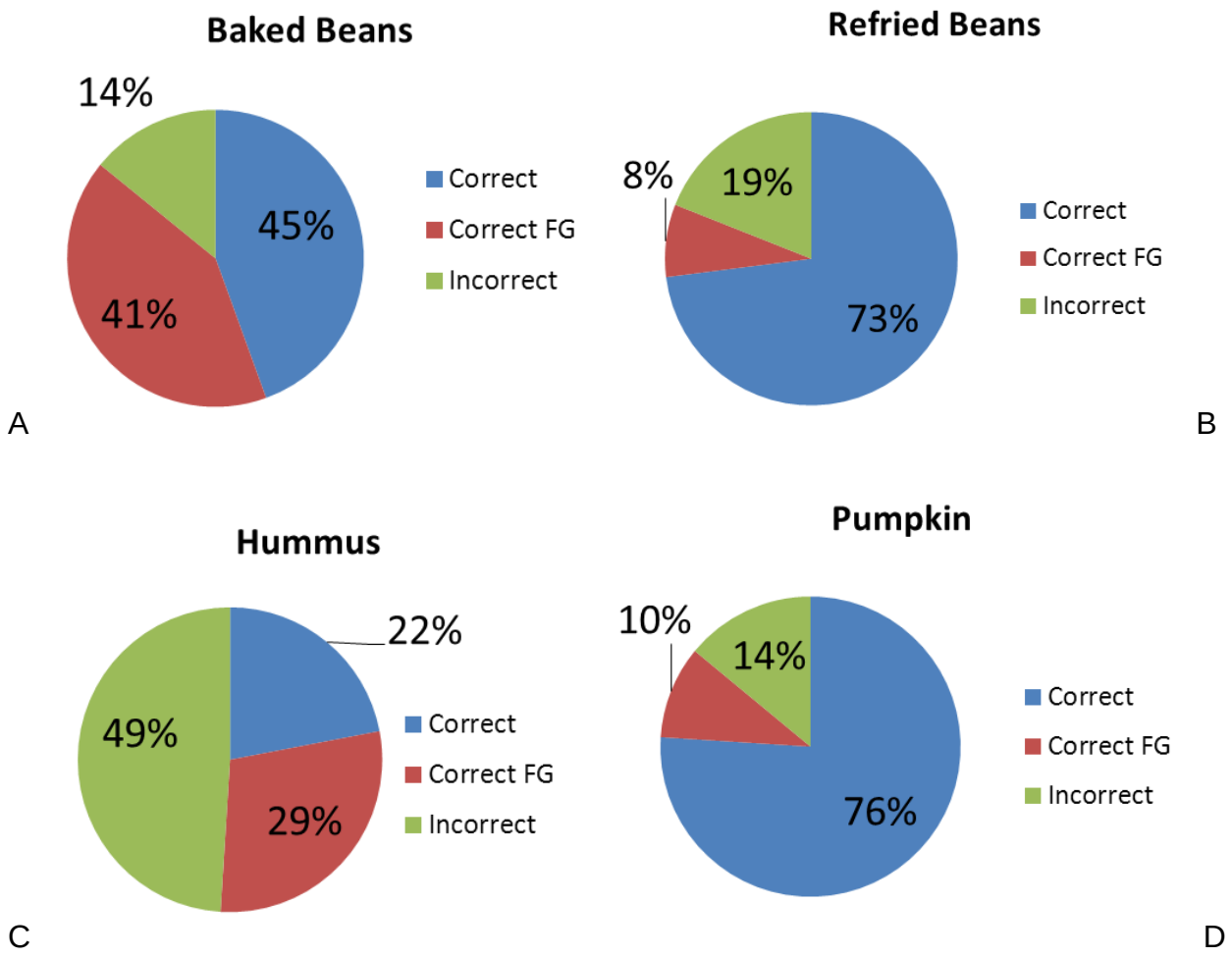


Figure 4-18. Identification accuracy of conventional purées by older adults A) Baked beans. B) Refried beans. C) Hummus. D) Pumpkin

Table 4-3. Overall acceptability versus identification accuracy of young adults

Sample	Spearman Coefficient	P-value
Unshaped Chicken	-0.010	0.927
Shaped Chicken	0.032	0.755
Unshaped Pork	0.007	0.950
Shaped Pork	-0.009	0.932
Unshaped Broccoli	-0.071	0.490
Shaped Broccoli	0.203	0.046*
Unshaped Green beans	0.009	0.927
Shaped Green beans	0.261	0.010*
Combination Beef Meal	-0.071	0.547
Combination Chicken Meal	-0.015	0.901
Individual Beef Meal	-0.103	0.383
Individual Chicken Meal	0.032	0.789
Regular Sodium Bread	0.094	0.361
Reduced Sodium Bread	0.180	0.078

Note: Ratings were compared to identification classification via Spearman Correlation Coefficient test.
*indicates significance at p-value < 0.05.

Table 4-4. Overall acceptability versus identification accuracy of older adults

Sample	Spearman Coefficient	P-value
Unshaped Chicken	0.058	0.660
Shaped Chicken	0.189	0.156
Unshaped Pork	-0.299	0.021*
Shaped Pork	0.015	0.908
Unshaped Broccoli	-0.060	0.658
Shaped Broccoli	-0.155	0.242
Unshaped Green beans	0.330	0.011*
Shaped Green beans	-0.315	0.015*
Combination Beef Meal	0.046	0.749
Combination Chicken Meal	-0.024	0.865
Individual Beef Meal	-0.170	0.237
Individual Chicken Meal	0.119	0.409
Regular Sodium Bread	-0.084	0.481
Reduced Sodium Bread	0.087	0.472
Baked Bean	-0.317	0.011*
Refried Bean	-0.019	0.883
Hummus	-0.076	0.556
Pumpkin	0.202	0.112

Note: Ratings were compared to identification classification via Spearman Correlation Coefficient test.
*indicates significance at p-value < 0.05.

CHAPTER 5
DISCUSSION

Given the hedonic gLMS is not as self-explanatory as other scales used in sensory research, training was provided to make sure all panelists understood how to appropriately use the scale. Yet, several panelists inappropriately used the scale and were excluded from data analysis. Examples of misuse include making multiple markings on the scale, writing words rather than a single point on the line, and using only extreme values (-100, 0, 100) with every question. Additional details in this matter are discussed within results of each study section. Further, although a guideline was followed for identification analysis, classifications were at the discretion of the researchers. It is possible that these could be modified and standardized if future studies were to be carried out to make the process as objective as possible. Nonetheless, identifications needed to be analyzed in a logical manner and this is the way it was done for these preliminary studies.

It is also important to note that acceptability ratings for certain products may not reflect acceptance of these products in an alternate setting, as every sample was presented at room temperature (within 19-25°C). The decision to serve samples in this temperature range was made for two reasons. First, it allowed ease of preparation and ensured panelists received and consumed the puréed food samples within the same general temperature range. Second, and more importantly, samples at a neutral temperature provide for optimal flavor perception, which was necessary in identification of samples. However, in choosing to use this temperature range for serving samples, there are a few limitations. It is obvious that acceptability ratings may in fact be lower than if the samples were presented at recommended serving temperatures. This is

probably most pronounced for the meat/poultry products and the vegetables. The bean and bread purées are likely more appropriate served at room temperature, as these products would likely be consumed at these temperatures. Further, identification accuracy may actually be skewed in favor of panelists who had a better chance at identifying a product that was served at this temperature. Nonetheless, puréed foods are commonly served in hospitals and long term care homes and by the time the patient receives the meal and actually consumes it, the temperature has often dropped substantially. Thus, it may be argued that the choice to serve room temperature samples is actually more reflective of the way puréed foods are often consumed, and would therefore be a better representation of acceptability and recognition accuracy.

Study 1: Shaped Purées

Sample Ratings: General

Samples were not completely randomized due to the large number of samples and limited labor. Instead, samples were randomized for each 10-person group (young cohort) and 20-person group (elder cohort). The differences in these groups are due to variations in testing site capabilities. Each set of randomized samples ensured that the same food (shaped and unshaped version) would never be subsequent to one another. For example, if shaped broccoli was presented in position one, than unshaped broccoli could not be presented in position two. Each sample was presented one at a time with sufficient time between samples to avoid sensory fatigue. Mean rating for favorite food was approximately 65 for older adults and 60 for young adults. Overall liking averaged from -9 for shaped green beans to 8 for unshaped chicken purée with older adults. Young panelists gave average overall liking ratings ranging from -6 for shaped green

beans to 5 for unshaped chicken. Overall these samples were near neutral on the scale and far from the ratings given to favorite food.

In general, the appearance of unshaped purées was preferred over the shaped purées. Among younger panelists, shaped pork and shaped green beans were significantly rated lower than any other samples, while unshaped chicken received the highest appearance rating. Older panelists also preferred the unshaped purées and higher appearance ratings were given to those samples, though the differences between samples were not as significant as with the younger group. With overall liking, there were not any differences in samples for older panelists. Young panelists preferred overall the pork and chicken purées over the vegetable purées, with the exception of unshaped broccoli which was rated similarly to the protein foods.

Ratings for mouthfeel did not really show a trend in either age group though there were significant differences between samples within each group. For flavor, students generally gave higher ratings for the pork and chicken purées when compared to the vegetable purées, regardless of whether it was shaped or unshaped. While differences were not as significant between samples for older panelists, this group seemed to care more about the shaping of the puréed food with regards to flavor, where unshaped purées were given higher flavor ratings. Since flavor is irrelevant to shape, it is possible the older panelists shifted their feelings of overall liking into the flavor category as a way to signify greater liking of this product. Given the shaped and unshaped purées were identical in product formulation, it is also possible that in disrupting the gel structure of the shaped purées to prepare the unshaped purées, there was an alteration in mouthfeel which may have been preferred. As such, the unshaped purées may indeed

have been perceived differently, simply from the manipulation of the molded structure in preparation of an unshaped sample.

Sample Ratings and Identification Accuracy: Young vs. Older Panelists

Overall, young and older panelists rated samples similarly and thus used the scale in a similar way. There were a few exceptions with each sample, most often with the attribute mouthfeel, followed by two instances with appearance and one with flavor. In each case, the older adults gave higher ratings when compared to young panelists. Since most of these differences were in relation to mouthfeel, it is possible the older panelists gave higher ratings because softer foods are generally consumed in greater quantities for this population due to issues with chewing and swallowing and thus this texture may be better accepted.

In terms of identification accuracy, young panelists were generally better at identifying foods correctly than older panelists. Both age groups had similar numbers of panelists who were categorized as “incorrect” respondents. The primary difference in age was observed in the “correct” and “correct food group” categories, where young panelists were more likely to get the correct food and older panelists were better at identifying the food group. This is consistent with previous studies and demonstrates that young panelists have keener taste acuity than older panelists, likely as a result of more discriminating sensory perception.

One of the objectives of this particular study was to evaluate the effect of shaped purées on identification accuracy. It was hypothesized that the shaped purée would be more easily identifiable since it would resemble the original food product in its natural form. It is curious to see that in fact, correct identifications were generally higher for the unshaped purées when compared to the shaped purées for both age groups. There are

several possible explanations for this finding. First, perhaps the shaped purées did not resemble the actual food well enough to these panelists. It is also possible that the foods, as a molded purée, seemed like such a foreign item to the panelists that a food group could not be associated. This is quite possible, as the texture and color of foods are inherently part of how humans recognize food items. With puréed foods, the texture is modified, the color may be slightly altered due to processing, and the shaping process may not be sufficient to make up for these modifications.

Study 2: Combination versus Individual Purées

Sample Ratings: General

Given the same food components, puréed foods presented as separate individual components received higher sample ratings, on average, when compared to the same puréed foods presented in a single combined purée. Favorite foods were ranked as 68 for older adults and 63 for young adults. Overall liking for combination chicken meal was rated 2 for older adults and 8 for young adults, on average. Mean ratings for the attribute overall liking with individual chicken were 30 for older adults and only 10 for young persons. Overall liking for combination beef meal was -18 for older adults and -16 for young persons. With the individual beef meal, older adults gave a mean rating for overall liking a -3 while older adults ranked this sample a 5. These values are far from the favorite food rating, particularly with the combination beef meal for both age groups. For older adults, the individual chicken meal was liked almost half as much as their favorite food, on average.

Because the individual purées were averaged to be compared to the single value of a combined purée, it is quite possible that one of the individual purée components resulted in an inflated mean. In fact, the potato purée was rated significantly higher than

all of the individual purées. Thus, the average of the individual purées may reflect the greater acceptability of the potato purée rather than the greater acceptability of individual purées in general. Nonetheless, if an older person were to receive the same meal presented individually and then as combined, it is possible that intake would be greater for the individual component meal as a result of increased acceptability of at least one of the puréed foods.

Essentially, since the potato purée was more acceptable, it would probably have a greater chance of being consumed. Even if the individual potatoes were the only puréed food consumed, it would still equate to greater intake than if the potatoes that were hidden in the combination purée and not consumed at all. It should also be noted that while the individual and combined purées included the same food types, these were not manufactured by the same company nor processed in the same manner. Thus, it is very possible the discrepancy between samples is a result of variations in the food source, quality, and processing parameters rather than simply a matter of presentation (i.e. individual or combined). This matter clearly needs to be further tested with other foods and combinations as well as with oral intake studies.

Regardless of whether the samples were presented as individual or combined purées, it was very clear that the beef meal was much less acceptable than the chicken meal. This was most evident with the combination purées, where both age groups gave significantly greater ratings for overall liking and flavor of the chicken meal over the beef meal. Upon closer inspection of the individual purées, specifically of the protein purées (chicken and beef), both age groups gave higher ratings for the chicken purée across all attributes (with the exception of appearance by young panelists who rated beef slightly

higher). This suggests that it is perhaps the protein source which is influencing acceptability ratings of both combination and individual purées. In fact, animal muscle proteins such as beef, poultry, and pork do not lend to puréeing as well as other high protein foods (beans, dairy, eggs), as things like gritty/sandy texture and poor flavor are common concerns. As with comparing individual versus combined purées, it is possible that differences in acceptability of beef versus chicken meals are a result of alterations in product formulation and not necessarily the food type itself.

Sample Ratings and Identification Accuracy: Young vs. Older Panelists

As mentioned above, the young and older adults were fairly similar in rating these samples. Both groups generally had higher ratings for the individual purées over the combination purées, the chicken meals over the beef meals, and the potato purée was the best liked puréed food of all of the samples. The primary differences in this study were observed in identification accuracy. Unlike the other studies where panelists were categorized at correct, incorrect, or able to identify the correct food group, it was more important to assess whether individual versus combined purées influenced identification accuracy. As such, panelists were categorized at correctly identifying zero (incorrect), one, two, or all three of the components.

As expected, when puréed foods were presented individually, correct identification of more foods occurred. This was especially evident for beef purées, where not one person in either age group could correctly identify the three foods in the combination purées whereas in the beef meal of individual purées, nearly half of older adults and over half of young panelists got at least two correct foods. The same was observed with the chicken meal, though a small percentage of both age groups were able to identify the three foods in the combination meals. Nonetheless, less than half

were able to correctly identify more than one correct food and many could not identify a single puréed food. With the chicken meal of individual purées, over half of each age group was able to identify at least two correct foods, similar to the beef meal.

In terms of age, the young persons were again better at identifying the foods than the elder group. With the chicken meal, every young person was able to identify at least one food whereas 10% of older persons were still unable to identify a single item. Considering both the combined and individual presentations of the chicken meal, young persons were better at identifying all three foods in the sample. With the individual beef meal, young persons had a higher percentage of persons getting at least one food item correct when compared to older panelists. These findings support the hypothesis that young people are better at correctly identifying puréed foods than older persons. However, there was one exception to this trend, where the opposite was observed. For the combination beef meal, there were more incorrect identifications (41%) by young panelists than by older panelists (31%). This finding is rather inexplicable, especially given the young group was much better at identifying the individual beef meal purées. Perhaps the older persons were more familiar with the aroma and flavor of the specific combination beef meal used in this study.

Study 3: Regular Sodium versus Low-Sodium Bread Purées

Sample Ratings: General

Overall, the bread purées were given fairly good acceptance ratings. Both bread samples were rated just under half as much as older panelists' favorite food. Older adults rated favorite food approximately 68 with overall ratings of regular and reduced sodium bread samples as 33 and 29, respectively. Young persons had a mean rating of 64 for favorite food and gave overall acceptability ratings a 21 for regular bread and 23

for reduced sodium bread. Unlike many of the samples tested in the other studies, there were no significant differences for any attribute between the regular and reduced sodium bread purées. This rejects the original hypothesis that regular bread purées would be more acceptable than reduced sodium bread purées. It is possible that the sodium range was not expansive enough to where panelists could pick out differences. Although 130 mg sodium is the general sodium content of an average bread slice, this quantity is still technically considered “low sodium” by FDA regulations. Thus, by government standards, both of these bread purées would be considered “low sodium” products. Perhaps if the study were done with higher sodium bread compared to “very low sodium” or “sodium free” bread products, a difference in acceptability would have been found. It should be noted that although statistically there were no disparities in ratings, several panelists in each age cohort made comments either verbally or in the identification section that the higher sodium product seemed “sweeter”, which was more preferable with this particular food matrix.

Nonetheless, if the majority of panelists are unable to pick out substantial differences between two products with a doubling of sodium content, the lower sodium product could be served without adverse sensory qualities yet with a better nutrient profile. It is also possible that this finding could extend to other products, especially grain-based products. Because many older adults on puréed diets are also on sodium restricted diets for various reasons, this could have significant implications. Reduced sodium puréed foods prepared in hospitals, long term care homes, and by personal caregivers are commonly prepared with very low sodium or salt free formulations, resulting in an unpalatable product. Rather than restricting sodium completely, if puréed

foods could simply be prepared with less sodium, as done in this study, perhaps acceptability would be enhanced and ultimately lead to increased intake.

Sample Ratings and Identification Accuracy: Young vs. Older Panelists

While there were no differences observed for the two bread samples within each age group, there were several significant differences between young and older persons, particularly with the regular bread purée. In general, older adults gave higher ratings across the board for every attribute in both samples. These ratings were significantly different for each attribute for the regular bread purée sample, though only significant for appearance and mouthfeel of the reduced sodium bread purée. This can possibly be explained by the larger discrepancy in acceptability of the samples by older adults, who appear to give slightly higher ratings for the regular bread compared to the reduced sodium bread and consequently have more significant differences for those attributes.

As expected, most panelists were able to identify the food or food group of this sample. It should be noted that the majority of these correct responses were a grain item other than bread. This can be explained by the fact that grain food products are inherently recognized by textural qualities and once this element is removed, it becomes increasingly difficult to discern one grain from another. Further, once a grain is made into a puréed food, it may begin to resemble grain products traditionally consumed as a puréed food or with a comparable texture, which is what was observed here. As such, responses were simply classified as correct (including all grain foods) or incorrect. In fact, most identifications were some type of cereal product such as oatmeal or cream of wheat rather than bread.

In terms of age groups, young adults had higher correct food and food group responses for both samples when compared to older adults as expected. When

comparing identification accuracy of regular versus reduced sodium breads, it is apparent the change in sodium content did not influence young panelists who had nearly identical accuracy values. However, for older adults there were much higher percent correct food/food group for the regular sodium bread purée compared to the low sodium sample. It is possible the sodium difference was more pronounced for older adults who may require higher sodium levels to better perceive flavors.

Study 4: Conventional Purées

Sample Ratings and Identification Accuracy

Conventional puréed foods are those foods which are consumed as purées by the general population, either as a whole food or as an accompaniment (e.g. a dip or filling). Three bean purées and pumpkin filling were chosen as samples for this preliminary study. Although only the older adults were used in this study, the findings are still important. Ratings for pumpkin and baked beans were rather high, especially compared to panelists' favorite food. Overall liking for pumpkin was given a 63 and baked beans a 39 compared to mean rating of 73 for favorite food. This means panelists liked pumpkin filling almost as much as their favorite food and baked beans a little over half as much. Refried beans and hummus received lower mean ratings, at 17 and 21, respectively. All samples differed significantly on the attributes "overall liking" and "flavor", with the highest to lowest rankings given to pumpkin, baked beans, refried beans, and hummus, respectively. No significant differences were observed in "appearance" and "mouthfeel" for baked beans and refried beans, though significant differences were apparent for pumpkin and hummus, with pumpkin again being the highest rating and hummus having the lowest ratings.

If purely evaluating actual ratings rather than statistical significance, it appears as though for each sample, acceptance ratings are in the same relative position across attributes. Essentially, for each attribute, pumpkin received the highest ratings followed by baked beans, refried beans, and finally hummus. It is possible that panelists did not distinguish between attributes, leading to a “dumping” effect, whereby one attribute influences the ratings of other attributes. For example, a panelist who really liked the flavor of pumpkin may have given high scores for all attributes, even if that individual did not necessarily think the appearance was equally acceptable. It is quite possible this effect was most pronounced for hummus, as many panelists commented that the sample was quite salty and that this feature negatively impacted overall liking. This issue could be addressed in future studies, where panelists could receive further training on differentiating attributes or perhaps a different scale could be used that is more straightforward.

While no direct comparison was made with non-conventional puréed foods, it was clear that the samples tested here were generally better received. After testing these particular samples, many panelists commented that these conventional puréed foods were much better overall than any of the other samples tested in previous studies. This clearly marks the need for future research with additional samples and comparison of acceptability with conventional purées versus non-conventional puréed foods. A study comparing across age groups may be useful as well, though this feature is most important when considering identification accuracy.

In terms of accurate recognition, the older adults generally did much better at identifying the correct food with the conventional puréed foods, most markedly with the

baked beans, refried beans and pumpkin. Hummus had a very high percentage of incorrect identifications. This can in part be explained by the fact that it is traditionally an ethnic food product that has gained popularity only recently in the United States. It is also possible that the saltiness and other flavor components including garlic and tahini masked the true flavor of the beans, making it difficult to identify. Pumpkin and refried beans had the highest correct identifications, likely as these were the most familiar and best fit the definition of a conventional puréed food.

Acceptability Ratings and Identification Accuracy

When exploring the relationship of identification accuracy and acceptability scores using Spearman correlation coefficient, no identifiable trend was observed. Although there were a few significant values, the highest correlation coefficient was only r=0.330 which is not considered a strong correlation. Thus, we can conclude based on this data that identification had little impact on overall likeability of a sample. It was originally hypothesized that correct identification would yield improved acceptability based on the logical assumption that recognition of a food being consumed would be better accepted than eating something unknown. However, there was no consistent trend with identification accuracy and acceptability ratings across all attributes for all samples tested.

CHAPTER 6
CONCLUSION

Puréed foods are important for persons with severe swallowing problems, most commonly older adults but may include young persons as well. For elderly individuals with dysphagia, decreased olfaction and gustation combined with texture modification may result in reduced sensory perception of a puréed food, particularly in terms of recognition. In general, both age groups had comparable incorrect responses with sample identification. However, young persons were better at identifying exact foods while older persons could typically only classify the food group. Young people appear to have a more discerning palate, yet older persons are still able to identify the general food item. Identification ability does not seem to influence acceptability of puréed foods. This is a key finding, as it suggests that perhaps food recognition is a superfluous component in puréed food acceptability. It appears that sensory characteristics are more important in influencing overall acceptability ratings.

Nonetheless, there is disconnect between these findings and what is reported in hospitals and long term care homes. Inability to identify puréed foods is a common complaint among older persons, yet this study found no relation between recognition and acceptability. Perhaps, the complaint is actually a manifestation of deeper emotions toward being on a puréed diet, including but not limited to the stigma of such a diet (may be perceived as “baby” food), the impact on QOL from such drastic dietary changes, or some other explanation. Because panelists used in these studies were not individuals with swallowing problems, it is also possible that dysphagia itself may interfere with the ability to identify foods and also influence acceptability. A portion of volatiles in a food are released after swallowing which directly impacts flavor perception. It is possible that

persons with swallowing difficulty do not have the same degree of flavor release in the ‘swallow breath’ as individuals without swallowing problems. Thus, future sensory testing with identification should be done using persons with dysphagia.

Acceptability is affected by several factors, including specific attributes within a food as well as how it is prepared and presented. Of those factors evaluated here, there were several worthy findings. First, it appears that traditional scooped puréed foods (unshaped) are much more preferred than the shaped counterparts. This has implications for manufacturers of shaped purées and long term care facilities and hospitals purchasing these items. Because shaped purées may be more expensive and less acceptable as observed in this study, it seems logical that these purées should not be produced and served. One of the largest differences observed between the shaped versus unshaped samples for every food was in mouthfeel, with shaped purées typically receiving lower scores. Because the food items were identical other than presentation, it is possible that in disrupting the gel structure of the shaped purée led to an unshaped purée which provided a more pleasant mouthfeel.

Shaping is not the only important quality of appearance in terms of panelists’ acceptability of samples. It appears that presenting puréed foods as whole individual foods is more acceptable than combining purées into one. It is not known whether this is because of differences in appearance, flavor, texture, etc. but it is important in understanding how puréed foods should be presented. Because individual purées had greater acceptability ratings, it is likely that this method of serving puréed foods would result in greater consumption. This is imperative, as intake is low for many older adults,

particularly those on a puréed a diet. Future studies could be done to evaluate consumption patterns with these two forms of meal presentation.

In addition to appearance, the issues of flavor and familiarity were addressed in the final two studies. In terms of flavor, salt is a key taste that allows flavors to be perceived optimally. Reduced sodium products generally do not have the same level of flavor as the regular sodium counterparts. In testing the two bread purée samples of varied sodium content, there were essentially no differences between the samples but there were differences in how each age cohort rated the samples. As there were no real differences between samples, it is possible that sodium content of other puréed foods could be reduced to the same level without adversely affected acceptability. Of course, additional sensory studies would need to be done to evaluate whether this pattern applies for foods other than the bread purée tested here. It is also important to note that the older adults gave generally higher ratings for both samples when compared to the young persons. This was especially true for the regular sodium bread purée, implying that older adults have a greater acceptance of the higher sodium product, perhaps as a result of increased flavor perception. Nonetheless, since there were no real differences between the samples, there are potential implications for reducing sodium in other puréed foods.

Conventional puréed foods which represent foods traditionally served as purées were generally the most acceptable products of all samples tested, with the exception of hummus. It is not clear whether these products were more accepted due to increased familiarity with consuming the particular food as a purée or because of superior sensory qualities. Even so, future studies should evaluate additional types of conventional

puréed foods as well as test direct relationships between conventional and non-conventional samples. If conventional puréed foods are more acceptable, perhaps the types of puréed foods currently being served at home and in long term care facilities or hospitals needs to be re-evaluated. It would also be vital to test consumption patterns for conventional versus non-conventional purées, as it is likely that intake will increased with a more accepted product. Serving conventional puréed foods may also reduce some of the stigma associated with a puréed diet, as even those without dysphagia will consume these types of puréed foods as part of a regular diet.

These studies highlight some important issues that need to be addressed in terms of product development and service of puréed foods. They also brought forth several questions that could be addressed in future studies. If the recommendations listed in this paper are taken into consideration for further research, it may be possible to improve not only puréed foods as a product but potentially quality of life of many individuals obliged to follow this type of diet.

Food Purée Taste Panel

Question # 1.

Please indicate your gender.

❍ Male
❍ Female

Question # 2.

Please enter your age.

_____

S C A L E

1. Now, please take a few minutes to identify the strongest **LIKING** (i.e. pleasure) of any kind that you have ever experienced.

2. Once you have identified your strongest **LIKING** experienced, please write it down in the space provided below.

3. **Please remember to use the strongest liking that you've identified and written down as the top of your scale (100).**

Please write the strongest **LIKING OF ANY KIND YOU'VE EXPERIENCED** in the space below, and remember that this will be 100 on your scale.

_____

_____

_____

S C A L E

1. Now, please take a few minutes to identify the strongest ***DIS*LIKING** (i.e. displeasure) of any kind that you have ever experienced.

2. Once you have identified your strongest ***DIS*LIKING** experienced, please write it down in the space provided below.

3. **Please remember to use the strongest *dis*liking that you've identified and written down as the bottom of your scale (-100).**

Please type the strongest ***DIS*LIKING OF ANY KIND YOU'VE EXPERIENCED** in the space below and remember that this will be -100 on your scale.

_____

_____

_____

S C A L E

PRACTICE QUESTIONS

On the line scale, 100 indicates the most intense liking (i.e. pleasure) you have ever experienced (no matter what the source). Similarly, -100 indicates the opposite: the most intense *dis*liking you have ever experienced. Neutral is indicated by 0.

<u>Please use your 100 and -100 (written on the paper provided) to answer the following questions.</u>

Eating your favorite food

Strongest Dislike		**Neutral**		**Strongest Like**
-100	0		100	

Eating your least favorite food

Strongest Dislike		**Neutral**		**Strongest Like**
-100	0		100	

Spending time with your loved ones

Strongest Dislike		**Neutral**		**Strongest Like**
-100	0		100	

The most intense anger you've experienced

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

The shyest you've ever been

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

The most inspired you have ever been by a lecture.

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

APPENDIX B
SAMPLE COMPUSENSE TEST BALLOT

Sample 213

Question # 1
Please use your **S C A L E 1** to rate the following attributes for **Sample 213**

Overall Liking

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Appearance

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Mouthfeel

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Flavor

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Question # 2
Please try to identify this food (**sample 213).** If you cannot identify it exactly, please guess the food or food group.

_____

_____

Please lift the window to receive your next sample.

Sample 213

Question # 1
Please use your **S C A L E 1** to rate the following attributes for **Sample 213**

Overall Liking

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Appearance

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Mouthfeel

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Flavor

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Question # 2
Please try to identify this food (**sample 213).** If you cannot identify it exactly, please guess the food or food group.

_____

_____

Please lift the window to receive your last sample.

Please lift the window to let the server know you have finished.

Thank you!

APPENDIX C
SAMPLE PAPER TEST BALLOT

Sample 213

Question # 1
Please use your **S C A L E 1** to rate the following attributes for **Sample 213**

Overall Liking

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Appearance

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Mouthfeel

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Flavor

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Question # 2
Please try to identify this food (**sample 213).** If you cannot identify it exactly, please guess the food or food group.

_____

_____

Please wait for your next sample, then continue to the next page.

Sample 213

Question # 1
Please use your **S C A L E 1** to rate the following attributes for **Sample 213**

Overall Liking

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Appearance

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Mouthfeel

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Flavor

Strongest Dislike	**Neutral**	**Strongest Like**
-100	0	100

Question # 2
Please try to identify this food (**sample 213).** If you cannot identify it exactly, please guess the food or food group.

_____

_____

Please complete this form then continue to the next page.

Please raise your hand to let the server know you have finished.

Thank you!

APPENDIX D
HgLMS TRAINING SHEET

1. Hello, today you will be tasting food purees and answering a few questions about the samples you taste.

2. Please answer the demographic questions appearing on the first page.

3. First, you will create your own personal scale to use for answering questions. The anchors you choose are for your use and will not be shared or used directly in this research.

- The top anchor of your scale, +100 will be the strongest liking of an experience you have had. Some examples are falling in love, traveling, or spending time with your family and friends.
    - Please write your +100 on the paper in front of you.
- The bottom anchor of your scale, -100 will be the strongest disliking of any kind you have ever experienced. Some examples are the death of a loved one or being very ill.
    - Please write your -100 on the paper in front of you.

4. You will use this scale when answering questions. Keep in mind that the values you select should be appropriate of how you personally rank the item relative to your anchors. For instance, pretend your favorite food is chocolate. If you like chocolate more than the time you were most inspired by a lecture, chocolate should get a higher rating.

- The same is true for negative statements. Pretend your least favorite food is brussel sprouts. If you dislike your most angry experience more than you dislike eating brussel sprouts, give your most angry experience a more negative value on the scale.

5. Giving a statement a rating of 0 means you neither like nor dislike the item.

6. Do not agonize over choosing an answer for any single question. Pick a number which you feel is representative and natural.

7. Now you will answer several warm-up questions based on the scale you have just created. These are meant to get you comfortable with using this scale. Keep your scale anchors in mind while you are answering these questions. You can refer to your anchors if you would like a reminder.

8. Now you will use this scale to rate samples of food purees. You will receive your first sample and be asked a few questions on that sample. Each sample is on ONE page.

9. When you finish answering questions for a sample, look up to the front of the room so we know you have finished. Once everyone in the group finishes, we will bring your next sample.

10. Things to keep in mind when tasting samples:

- Take a bite of cracker and sip of water BEFORE EVERY SAMPLE to cleanse your palate. If you need more water or crackers, please ask one of the workers.
- Make sure the number on your sample cup matches the sample number on the page for the questions you are answering. Again, each sample gets ONE page of questions.
- Finally, and most importantly, do NOT talk to other panelists during testing.

Does anyone have any questions?

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BIOGRAPHICAL SKETCH

Jamila René Lepore was born in Dunedin, Florida and is the daughter to David and Jane Frazier. She has two sisters and one brother, whom she loves dearly. She started her undergraduate college career at New York University before she decided to pursue a degree in dietetics at the University of Florida, where she graduated in 2010. The following year, she completed a dietetic internship and passed the national registration exam to officially become a Registered Dietitian. Jamila continued her educational studies by returning to the University of Florida to complete a Master of Science degree in food science in two years. In her second year, she married Dr. Ryan Lepore DMD, a graduate of the University of Florida. She is passionate about nutrition and food science and would like to pursue a career that incorporates either or both of these specialties.