Brown/White Rice, Consumer Acceptance

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Rice is consumed as a staple food by more than half of the world's population. Due to a higher fibre and micronutrient content, brown rice is more nutritious than white rice, but the consumption of brown rice is significantly lower than that of white rice, primarily due to sensory attributes. Therefore, the present research aimed to identify the sensory attributes which drive liking of Australian-grown brown and white rice varieties. Participants (n = 139) tasted and scored (9-point hedonic scale) their liking (i.e., overall liking, aroma, colour and texture) of brown and white rice types of Jasmine (Kyeema), Low GI (Doongara) and Medium grain rice (Amaroo). In addition, participants scored, aroma, colour, hardness, fluffiness, stickiness and chewiness, on Just About Right Scales. A within-subjects crossover design with randomised order (William's Latin Square design) was used with six repeated samples for liking and Just About Right scales. Penalty analyses were applied to determine the relative influence of perception of sensory attributes on consumer liking of the rice varieties. Across all varieties, white rice was liked more than brown rice due to texture and colour, and Jasmine rice was preferred over Low GI and Medium Grain. Rice texture (hardness and chewiness) was the most important sensory attribute among all rice varieties and aroma was important for driving of liking between white rice varieties.

brown rice white rice sensory consumer acceptance Just About Right scale JAR penalty analysis

1. Background

Rice is consumed as a staple food by more than 4 billion people around the globe [1][2][3]. Rice is a significant source of dietary nutrients such as carbohydrates, vitamins, and minerals [4][5]. For populations that rely on rice as a staple food, it delivers approximately 21% of the consumed energy and 15% of the consumed protein [6].

The sensory profile of rice is an important driver of consumer acceptance. Sensory attributes have a strong influence on product selection, consumption, and purchase decisions [7][8]. Sensory attributes such as physical appearance (i.e., uniformity, cleanliness, brightness, glossiness and translucency of the rice grain) [9], taste (e.g., sweetness, bitterness), and aroma (e.g., floral notes) are drivers of liking [10] that affect consumer acceptance of rice.

Furthermore, rice texture (i.e., cohesiveness, softness) has been suggested to be of high importance for consumer acceptance of rice. A previous study reported that brown rice texture was less liked compared to white rice and there was variation in liking of the various textures of different brown rice varieties [11]. Along the same lines,

Suwansri et al. suggested that an increase in the hardness of rice is associated with a lower consumer acceptability [12]. The importance of texture has also been emphasised by Maleki et al., who suggests that consumers can be segmented based on their preference for different rice textures [13]. In their study, fluffiness was a driver of liking for the majority of consumers (44%), whereas for smaller segments of consumers, liking was mainly driven by flavour attributes.

Within each rice variety, the milling process (e.g., white vs. brown rice) alters the nutrient composition and sensory attributes [14]. For example, brown rice has a higher lipid content compared with white rice. The lipid context affects the sensory profile due to lipid oxidation in the bran layer of brown rice [15]. Lipid oxidation leads to the development of off flavours [16], which potentially impact consumer perception and acceptance. In short, differences in the acceptance of white and brown rice are likely caused by differences in sensory profiles, which are related to differences in nutrient composition [17].

In Australia, 90% of rice is consumed as white rice, whereas only 10% is consumed as brown rice [18], which is similar to global rice consumption patterns [18][19]. Brown rice is considered a healthier option than white rice [20]. To understand what drives the difference in consumption of brown and white rice, it is important to investigate the sensory differences of brown and white rice.

The objective of this study was to identify the drivers of liking of Australian grown brown and white rice varieties. It will provide important information for rice industry and breeding programmes for the development of new rice varieties to meet consumer needs.

2. Method

Participants (n = 139) tasted and scored (9-point hedonic scale) their liking (i.e., overall liking, aroma, colour and texture) of brown and white rice types of Jasmine (Kyeema), Low GI (Doongara) and Medium grain rice (Amaroo). In addition, participants scored, aroma, colour, hardness, fluffiness, stickiness and chewiness, on Just About Right Scales. A within-subjects crossover design with randomised order (William's Latin Square design) was used with six repeated samples for liking and Just About Right scales. Penalty analyses were applied to determine the relative influence of perception of sensory attributes on consumer liking of the rice varieties

3. Results & Discussion

This study aimed to identify the consumer liking, sensory attributes, and drivers of liking of brown and white rice varieties. The results suggest that, overall, participants liked Jasmine rice varieties more than Low GI and Medium grain rice varieties. This was also reflected in a higher liking of the aroma, colour, and texture of Jasmine rice, compared to Low GI and Medium grain rice varieties. However, white rice was preferred over brown rice regardless of rice varieties.

The present study suggests, in line with previous studies [12][17][21][22], that texture, colour, and aroma are important drivers of consumer liking for rice. However, these drivers of liking do not seem to equally explain the differences in liking of white and brown rice. Indeed, differences in aroma mainly explain the difference in liking for white rice varieties and the aroma of Jasmine white rice was liked more than any of the other rice varieties. The most liked white rice (Jasmine rice), contains more of the compound 2-acetyle-1-pyrroline [23] which is known to elicit a distinctive popcorn/pandan aroma [3][24][25][26] that has a strong impact on consumer acceptance of rice [27]. On the other hand, the other white rice (non-fragrant) varieties contain less 2AP [28][29][30] that may have an impact on liking of non-fragrant white rice varieties. This is also reflected in the sensory data of the present study that aroma of Jasmine white rice is an important sensory attribute in predicting consumer liking and acceptance of white rice varieties. Therefore, the aroma of Jasmine white rice was preferred over all other white and brown rice varieties. In contrast to aroma being able to explain liking differences for white rice varieties, aroma does not fully explain differences in liking for brown rice.

Differences between brown rice varieties can be explained by texture (hardness and chewiness). This means that brown rice is considered as too hard and chewy in texture, which is driving the difference between brown rice varieties, whereas Jasmine brown rice was preferred over Low GI and Medium grain brown rice. The results are in line with a previous study conducted on ready-to-eat rice in Korea which concluded that the brown rice was scored less in overall acceptability due to being high in hardness, chewiness, and yellowness [11]. Brown rice hardness in texture is associated with dietary fibre that is present in bran layer [31] whereas, in white rice, polishing removes bran and germ during rice processing [32]. This significantly improves texture liking and consumer acceptance of white rice. In contrast to previous studies, which used a combination of descriptive analysis and hedonic scaling [9][11][12][13], the current study investigated consumer acceptance of rice by utilising 9-Point hedonic scales, JAR scales, and penalty analysis. Penalty analysis is a powerful tool to analyse the decreases in acceptability associated with sensory attributes which are perceived by consumers as being not optional [33][34]. This study also compared a range of brown and white rice varieties which enabled to compare brown and white rice, but also identify the drivers of liking between brown rice varieties as well as the drivers of liking within white. In addition, it is interesting to note that rice texture (hardness) is more important for the consumer acceptance and overall liking of Australian brown rice varieties. This study suggests that the decrease in hardness and chewiness will increase the overall liking of Australian brown rice varieties, which can eventually increase brown rice acceptance and consumption.

Brown rice texture (hardness and chewiness) and colour are the sensory attributes that are driving the difference between white and brown rice varieties. Thus, the texture of brown rice is less liked as compare to white rice regardless of rice varieties, because the majority of participants rated brown rice varieties as too hard and too chewy. However, differences in texture seem to be more important when comparing liking between white and brown rice. This is in line with a study conducted on consumer acceptance of parboiled brown and white rice which reported that white rice was preferred to brown rice because of texture and colour [17]. The results are also in agreement with the study that reported consumer acceptance of white rice varieties in Thailand, in which the participants preferred cooked white rice because of the soft texture [21]. Suwansri and Meullenet (2004) reported that Asian consumers preferred rice with white appearance (colour) and less sticky texture [35]. Similarly, the

consumers from South Asia and Middle East did not prefer the brown rice texture [36]. In the present study, the sensory results also suggest that brown rice texture (hardness and chewiness) is the most important sensory attribute that is driving the liking and consumer acceptance of brown rice.

Although this was the first study which investigated consumer acceptance of Australian brown and white rice varieties, there are some limitations which need to be taken into consideration. The participants were mainly living in urban areas and were well educated, with 79% of participants holding undergraduate degree or higher. That may have affected their liking because of their awareness of the brown and white rice varieties which may cause bias in evaluation of rice attributes. For future investigation, the sample (participants) could be recruited from different geographical areas to predict the preference of Australian brown and white rice varieties. It is suggested to conduct future studies with a greater focus on the texture attributes of brown rice. To identify the variability in the texture of brown rice, different cooking methods and water to rice ratios are recommended. In addition, the instrumental analysis (colour and texture analyser) can be considered for the better understanding of texture attributes of brown and white rice varieties.

4. Conclusions

Texture is the most important sensory attribute which explains the difference in liking between brown and white rice, whereas differences in aroma best explain the variation in liking of white rice. Therefore, to increase the acceptance and consumption of brown rice, development needs to mainly focus on the improvement of the texture acceptance of brown rice. Future research is needed to investigate if an increased water absorption, milling process, packaging, and storage of brown rice can positively improve the texture and subsequently increase consumer acceptance.

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