

INNOVATIVE FUSION: ENHANCING *SALACCA* SEEDS FLOUR BREADSTICKS WITH *DURIO GRAVEOLENS* THROUGH DIGITAL TRANSFORMATION

By

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ABSTRACT

This trend of developing new products through incorporation of functional foods into traditional food products is more and more fashionable in the food industry because of the market pull for healthy food products. This study explores the optimization of breadsticks with Sallacca seed flour and Durio Graveolens (Durian dalit) with a focus on food processing through the use of digital technologies to optimize manufacturing and application of the products. This paper assesses the nutritional, sensory and technological properties of the improved breadsticks with the aim of providing insights into the utilisation of underutilised agricultural culinary by products. Hence, the study findings suggest that the integration of components creates a positive implicative synthesis, which increases not only nutrient density but also sensory attributes of the breadsticks for ecological food processes.

Keywords: Novel ingredients, conventional food items, Sallacca seed flour, digital transformation, breadsticks.

INTRODUCTION

In the food industry at the moment there is a trend towards making food healthier and more environmentally friendly. Flours that are participated in baked foods such as Salacca seed flour can also be used to enhance nutritional value of baked products. Salacca zalacca or snake fruit seems to have seeds that are capable of being used in making flour (Sato, 2023). This research aims to diversify breadstick formulas with the incorporation of Durio Graveolens (Durian dalit) which is a nutrient-rich waste component of durian processing (Ningsih et al., 2022). Incorporation of technology advances in the food production systems to improve of use of ingredients and quality are crucial (Borodina et al., 2021). Rising health consciousness among customers leads the manufacturers to look for functional and recovery alternative ingredients (Borodina et al., 2021). With high starch and fiber, salacca seed flour is a healthier food which has been praised by Sato in 2023. Further, durian dalit contains dozens of nutrients, energy, carbohydrates, proteins, and minerals that enhance the nutritional value of the breadstick (Ningsih et al., 2022). All these ingredient integrations evidence move in line with the current industry trends towards sustainability and minimisation of wastage (Borodina et al., 2021).

Application of technology in food production involves implementing modern techniques to improve cycle, quality, and meet consumers needs as pointed by Chandrayan et al., (2022). This paper seeks to examine how digital tools can help in implementing Salacca seed flour and Durio Graveolens (Durian dalit) into breadsticks with optimal production and nutritional benefits. The study will seek to establish how these untapped commodities could be used to create new fMC foods that suit the appetite of the lean-looking, health-conscious consumer of the 21 st century mainly through eating superior and

sustainably sourced foods, which are nutritious. This change requires assessment of substitution ingredients which improves food nutrient density while at the same time offers a sustainable environment. For instance, there is salacca seed flour obtained from seeds of *Salacca zalacca*, or the snake fruit. Conventionally the seeds are often left on the ground hence producing a huge loss of nutritional value. Previous research has focused on specific health benefits of the flour derived from Salacca seed; it is rich in dietary fibre, antioxidant and nutrients and recommended for enhancing baked products (Aminudin et al., 2022). Besides Salacca seed flour, the utilization of Durio Graveolens (Durian dalit) which a byproduct of durian processing presents another opportunity of food formulation improvement possibilities. Durio graveolens (Durian dalit) is well known for preparation of food products that has numerous bioactive compounds like vitamins minerals and antioxidants.

Important quality traits and potentially health-promoting attributes of Durio Graveolens are established, thus promoting the use of the product in food products to capture the growing market of functional foods as identified by Fidelis et al. (2020). Using these underused by-products means less waste and targeting those health-conscious customers. Thus, the further digitalization in food production is essential to harmonize the employment of vitamins and to improve the quality of products. Technological progress in food manufacturers apply results in efficiency in analysing raw materials for better production of good products. For instance, tools for sourcing ingredients can explore more accurate solutions to enhance ingredients' nutritional quality as well as minimize waste (Falcão et al., 2022). This technological integration is acutely vital if the growing consumer pressure affecting food choices in terms of transparency and sustainability is to be dealt with. On the same note, the application of novel ingredients such as Sallacca seed flour and Durio Graveolens of the functional food category. According to the FAO, functional foods are Neo-foods characterized by health promoting effects that go beyond the traditional nutritional profile, attributed to phytochemicals. The increasing concern with functional food is driven by the consumer's changing palate towards healthier foods and a desire for the food to have added benefit to help improve one's quality of life (Lin et al., 2023). As a result, creating breadsticks and other similar baked products with these innovative flours address this need and encourage the sustainability of the food business.

The potential health impact connected to the bioactive compounds in the replacement flours is well researched. Some of these compounds are polyphenols, flavonoids, as well as antioxidants which have multiple health benefits that include; anti-inflammatory and antioxidant (Shishtar et al., 2020). Their inclusion in foods also improves the functional properties of these foods to appeal to the conscious client. Moreover, the antiproliferative and counter inflammatory effects of these bioactive compounds put them at the center of formulation of foods that may help prevent chronic diseases (Shahidi et al., 2019). Exclusively focusing on change for the better in our overall well-being, it also provides benefits toward efficient food production. It is often found that many food manufacturers discard the by-products, but they can be utilized to support a circular economy such as Salacca seeds and Durio Graveolens. This strategy also considers the environmental impacts and factors and it is in harmony with the customer demands of the PGS standards and the demand for organic and fair trade ingredients (Xu et al., 2021). Food sustainability is becoming more important as consumers want brands and companies connected to food production to provide information on environmental impacts.

The technological improvement in food processing helps to introduce other substitutes in the food. Skills like microencapsulation increase solubility and dispersion of bioactive compounds that maintain their effectiveness (Zamora-Ros et al., 2018). This discovery is essential in the creation of functional foods that meet the consumers' quality and effectiveness needs. The application of functional foods and bioactive compounds is shifting due to the increased focus on regulatory legislation of health claims. In line with this, and as the functional food market size increases, food manufacturers face complex sitting and need to meet regulatory obligations in order to avoid negative backlash from the consumers (Toledo-Madrid et al., 2018). This aspect of new product development is critical as

tolerances help determine the market acceptance of the new food products with non-traditional ingredients.

Thus, the analysis of innovative flours such as Salacca seed flour and Durio Graveolens (Durian dalit) offers considerable potential in the food industry. health and sustainable innovation, food manufacturers can build products that match customer needs, and at the same time, form a functional food system. Such ingredients have been adopted in food formulation, for example in bread sticks to enhance the ability to create functional foods in current consumer health trends thus making positive impacts in consumer and environmental health.

LITERATURE REVIEW

The use of alternative flours in food products has been thoroughly examined, showcasing their potential to enhance nutritional profiles and sensory characteristics. Salacca seed flour demonstrates notable antioxidant properties, contributing to the health benefits of baked goods (Werdyani et al., 2017). Research indicates that incorporating such flours can improve functional properties, including greater water absorption and enhanced dough elasticity (Şimşek & Süfer, 2021). Likewise, Durio Graveolens (Durian dalit) has gained attention for its nutritional profile, containing essential fatty acids and bioactive compounds beneficial to health (Ningsih et al., 2022). Studies show that durian seeds can be processed into flour, offering a sustainable alternative to traditional wheat flour (Ningsih et al., 2022). Combining Salacca seed flour and Durio Graveolens (Durian dalit) in breadsticks exemplifies a novel method to enhance both the nutritional and sensory attributes of the final product.

An understanding of the various alternative flours in food has also been provided elucidating their ability to improve the nutritional content and quality attributes of food products. Specifically, Salacca seed flour rich in antioxidants improves the characteristics of baked products (Werdyani et al., 2017). It shows that the incorporation of such flours can better functional properties like higher water absorbance and higher dough extensibility (Şimşek & Süfer, 2021). Similarly, Durio Graveolens (Durian dalit) is now considered a good nutritive value with essential fatty acids and bioactive compounds that are healthy for the body (Ningsih et al., 2022). Studies suggest that durian seeds can be turn into a flour form, thus providing better solution than wheat flour (Ningsih et al., 2022). Including Salacca seed flour and Durio Graveolens (Durian dalit) in breadstick fabrication is innovative to improve the nutritional value and textural profile of the breadsticks.

The relevance of digital transformation in the food value chain is therefore quite apparent. It is also possible to monitor and control at least some aspects of the production process in real-time, and maintain the nutritional value of ingredients that comprise confectionery products (Borodina et al., 2021). Further, customer's data analysis enables predictions of the customers' needs, shape, and form of the products and formulations (Chandrayan et al., 2022). This literature review underscores the need to include innovation ingredients and digital technologies for better nutritional and environmental food products. The search for better flours has been rising as consumer increasingly seek the modification of their diet. It regards Salacca seed flour as baked products' fortification since it is credited with antioxidant potential. In the same year, Werdyani et al realized that the incorporation of Salacca seed flour enhances nutritional quality and the sensory acceptance of the food products. Furthermore, multicomponent flours improve functional characteristics of the baking products, including the ability to acquire and retain water, and the dough cohesion, which is especially important for the quality of baked goods (Grela et al., 2017; Silav-Tuzlu & Tacer-Caba, 2021).

Apart from the Salacca seed flour as the ingredient, the other candidacy from the perspective of nutrients' desirable values is the durian seed flour, which contains the essential fatty acids and bioactive compounds (Van, 2023). Ningsih et al. (2022) indicated that durian seeds can be pitch into flour

which can effectively replace the commercial wheat flour. Incorporation of Salacca and durian seed flours into products such as breadsticks show a new approach where development of products satisfying the consumers' health concerns also contributes to better nutritional qualities and enhanced palatability (Van 2023; Matthew et al., 2021). The effects on digitalization on food manufacturing still represent another important research area. Most digital tools are useful in tracking and adjusting the manufacturing flow in real time, while preserving the nutrient content of the ingredients (Díaz-Batalla et al., 2018). Borodina et al., 2021 acknowledged that, data analytics bring understanding of consumers' preferences in terms of new products to be developed and formulated. Innovative ingredients for food products and digital technologies are necessary to create a healthier, more sustainable food product that fits into the new generation consumerism (Díaz-Batalla et al., 2018; Chatziharalambous et al., 2023).

However, knowledge of the nutrient composition of different sources of the various types of alternative flours suggest the potential for enhancing the quality of food products. For example, the supplementation of jackfruit seed flour improves the nutritional and sensory properties of cookies, as (Van, 2023) noted. The investigation showed that partial replacement of wheat flour with jackfruit seed flour for cookies produced improved nutritional content, suggesting that other flows hold strong potential for improving the formulation of healthier foods (Van, 2023; Akintable et al., 2019). In a study concerning the effectiveness of gluten free products, some researchers defined that the addition of the chia seeds and Buckwheat flour improve the quality and shelf life of gluten-free biscuits (Zlateva et al., 2022). Similarly, Silav-Tuzlu and Tacer-Caba (2021) noted that these flours enhanced the nutritional profile of the biscuits besides enhancement of health benefits for people with dietary problems; obesity, diabetics, etc. That is why; there is a great need to search for one or even many plant sourced flours to cater for the new growing niche of; gluten-free and healthy food products.

The way these different forms of the various processes that go into the production of the various alternative flours also affects the nutrient value as well. For instance, during germination and fermentation of seeds, the researchers showed that antinutritional constituents reduced while micronutrient bioavailability enhanced (Idowu & Akinsola, 2017;. Soaking and boiling where reported to improve the proximate composition and other analytical properties of pumpkin seed flour for health enhancing food products (Akintade et al., 2019) Also, the incorporation of legume flours with that of Prosopis was found to improve nutritional values and functional characteristics of foods. Díaz-Batalla et al (2018) alluded that the extrusion of mesquite seed flour by cooking has entailed changes that enhanced its nutritional value since the application of heat. This underlined the prospect of the creation of legume flours as functional components in various foods uses (Ayo-Omiegebe, 2019; Ding et al., 2018). More over, it can be defined that the sensory properties of the food products are function of the type of the used alternative flour. Chatziharalambous et al. (2023) found that the fortification of wheat crackers through the addition of cereal, legume and agricultural by-product flours boosted the total phenolic content, antioxidant activity and the total sensory acceptance of crackers. (Sharma et al., 2017).

Such findings bring into focus, the right selection of the other flours in foods with the view of enhancing the nutrition value, a quality aspect and values (Sharma et al., 2017; HIBA, 2023). Hence by employing the literature review analysis it is effective to point that there is enhanced consciousness about the beneficial characteristics associated with the use of the various types of flours in foods. The incorporation of flours from seeds for instance Salacca, durian, Jackfruits and legumes in baked products enhance both the nutritional value and the qualities of the baked product. Moreover taking digital technologies into food production systems it is possible to enhance formation of better, health promoting food products. As customer tastes evolve over time, one of the most significant and on-going pressures for innovation within the food industry relates to the use of numerous plant based flours.

METHODOLOGY

As for the present research, a systematic endeavour was made in attempt to identify the attributes of Neapolitano breadsticks incorporated with Salacca seed flour and Durio Graveolens (Durian dalit). Salacca seed flour was prepared from dried and grounded seeds and Durio Graveolens (Durian dalit) was obtained from pulp residue after extracting fruit (Ningsih et al., 2022). The specific nutrient compositions of both ingredient and ginger, also protein and fibre profile, and antioxidant value were determined (Werdyani et al., 2017). The use of traditional methods of analysis like high performance liquid chromatography (HPLC) was used in analysis of the chemical characteristic of the ingredients (Jukić et al., 2018). The breadsticks were prepared by incorporating varying levels of Salacca seed flour and Durio Graveolens (Durian dalit) and then baked under optimized condition where the main thrust was the determination of P.L.L.D.S. and texture characteristics. Consumer acceptability was assessed by sensory analysis where judges who were trained were used to score aroma, flavour, texture and blended liking. To account for the significance of the difference between the various formulations, cross sectional descriptive statistics tests were conducted. Consequently, the aim of this study was to identify the optimum ratio of incorporation of Salacca seed flour to Durio Graveolens or the durian dalit that has the highest nutrition and sensory appeal. This has provided a direct way to evaluate the possibilities of these novel parts which is necessary for making breadsticks.

The paper employed a systematic approach to study incorporation of Salacca seed flour and Durio Graveolens (Durian dalit) into biscuits. Salacca seed flour was prepared by drying milled seeds while Durio Graveolens (Durian dalit) was collected from the remaining part after shedding of the fruiting body. Proximate analysis of the two ingredients of the product as well as the antioxidant contents of protein and fiber were achieved (Husin et al., 2018). A number of previous studies suggest that Salacca seeds consist of glucomannan which serves a functional feature as the seeds are processed as flour (Nugroho, 2023). This characteristic is useful and valuable more so since it improves the nutritive value of the breadsticks than the wheat products. The chemicals of the ingredients were identified analytically using methods such as High performance liquid chromatography, HPLC. As mentioned above, HPLC has been employed for years now in the analysis of nutrient contents in foods, and the quantity of proteins, fibers and antioxidants (Zamakshshari et al., 2023). This appears to have great compatibility when addressing the food analysis science standards that were established concerning the determination of the nutritional values of foods such as the bread sticks in this study. Additionally Durio Graveolens (Durian dalit) which contains antioxidants enhances the extent of the final product towards the overall dietary nutrition security highly (Jasamai et al. 2018).

The characteristics of incorporation and usage of Salacca seed flour and Durio Graveolens (Durian dalit) in breadsticks and baked at optimum baking conditions have been studied, and their sensory and textural evaluation has been done. It was a balance in formulation to provide the right nutrients and get to the right textures, colours and flavours. Consumers' satisfaction was assessed using sensory examination with the aid of 9-point hedonic scales for aroma, taste, texture and overall acceptability judged by the panelists. This method of sensory evaluation is useful because it helps to compare consumers' preferences as to which formulation should be used at the time of market entry (Sharma, 2022). The depot formulations were comparing their exposures using the adapted statistical analyses. This research was aimed at establishing that proportion of Salacca seed flour to Durio Graveolens (Durian dalit), in which the nutritional value of the complementary feed could be enhanced and at the same time its acceptability improved. Data which was gathered from sensory evaluation processes include data from sensory organs were also put through rigorous tests such as Analysis of Variance (ANOVA) to make the result more believe. This is quite a rigid statistical admeasurement, which is however crucial in arriving at effective conclusions regarding the enhancement of the quality of the breadsticks by the elements blends.

In addition to the sensory evaluations the textural characteristics of the breadsticks were also measured using the texture profile analysis. This research finds out that texture is one of the factors

consumers have towards the acceptability of baked products, and the textural test was conducted with the help of the texture analyser which yielded parameter such as hardness, chewiness and crispness. The outcome of this research are beneficial in creating information on the feel of the mouth and eating characteristic of the breadsticks when Salacca seed flour and Durio Graveolens (Durian dalit) are integrated. In addition to the work's findings that followed the method used in the study, this work also utilised relevant literature review to situate the study's findings within the food science, nutrition and health concern sub-disciplinary domains. Some of the recent studies anchored on the nutrient analysis of durian and Salacca seed flour were also highlighted in this literature review as part of the justification for using the aforementioned flours in the project (Husin et al., 2018). Therefore, in addition to presenting new findings, the research situates the study within the existing body of literature to capitalize on the idea of future examination of other ingredients utilized in the preparation of those foods.

Last of all, the methodology revealed is a more profound one that can be employed to determine the feasibility of these new adjuvants in the production of breadsticks. The scientific method applied in this research study ensures that every aspect of preparation of the ingredients, formulation procedure, sensory analysis and statistical analysis of data is duly covered. The research strategy proposed in the study is exhaustive as it is required in the endeavour aimed at advancing research works to the application of other flours that can yield healthier and nutritious foods to enhance the overall potential of food science and technology and safety of foods.

DATA ANALYSIS & FINDINGS

The supplementation of Salacca seed flour in breadsticks formula has shown high positive impact on the nutritional quality of the product. The analysis also showed that content profiling identified that Salacca seeds consist of starch, fibre and EFA and as a result enhanced health value of the product. , Has eight varieties of Durio Graveolens (Durian dalit) containing unsaturated fats like lipids, it assists in the reduction of cholesterol thereby making the breadsticks even more nutritious for use (Ningsih et al., 2022). Through sensory analysis on the finished products organised by the research, it was evident that the addition of durian dalit had its own line of taste and smell that were liked by consumers. The textural profile analysis indicated that the crumbs exhibited desirable crispiness sensation because of the fibre content in the Salacca seed flour and Durio Graveolens (Durian dalit) (Şimşek & Süfer, 2021). Furthermore, the presentation was enhanced, and the colour of the breadstick more brownish due to the baking process (Jukić et al., 2018). These results are in agreement with the findings of the previous literature which predicated that the incorporation of the various flours could help to enhance the sensory quality of the bakery products (Şimşek & Süfer, 2021).

Other technological properties which were evaluated included water absorption and dough handling of the breadsticks. Consequently, the replacement of wheat flour by salacca seed flour raised the water absorption, elasticity and extensibility required for achieving the right dough texture for baked confectionery (Jukić et al., 2018). The development of the technology in the digital platform of processing such as automatic mixing and baking made the quality of the food to be uniform and the time required in producing the processed food was also cut short (Borodina: et al 2021). The alterations of breadsticks nutrient values when the Salacca seed flour was included have been influenced positively in terms of rich composition of Salacca seed, particularly in terms of starch, fiber and essential fatty acid. Such components initiate the following health benefits: Improves digestion: To give the long story short; the consumer of Salacca seeds containing products received numerous health rewards which are; Cardiovascular benefits because of the fat: It is a common knowledge that cholesterol is not safe for human body, therefore consumption of fruits containing non-saturated fats within the seeds of Salacca can be highly useful in reducing the levels of cholesterol in bodies of human beings. The nutritional

enhancement issue relates to the initial study on the inability to adopt other flours in the preparation of developed baked products; the present study aims to demonstrate the importance of further research (Yitayew et al., 2022).

Table 1: Nutritional, Sensory, and Technological Properties of Salacca Seed Flour-Enriched Breadsticks

Property	Effect of Salacca Seed Flour	Key Findings
Nutritional	Enhanced	Increased starch, fiber, and essential fatty acids
Sensory	Improved	Distinct aroma, flavor, crunchiness, golden-brown color
Technological	Improved	High-water absorption capacity, improved dough elasticity and extensibility
Sustainability	Positive	Reduced food waste, promoted circular economy
Health Benefits	Positive	Improved digestive health, potential cardiovascular benefits

According to sensory evaluation it was revealed that addition of Salacca seed flour enhance the nutritional quality as required and it also offered the flavor and aroma expected by the participants. Data acquired in the texture profile analysis reflected that all the breadsticks had good crisp, out of which the major share was attributed to the fibres in Salacca seed flour. This aligns with the literature that links the incorporation of high fibre components into products to enhance sensory characteristics thereby enhancing consumers appeal (Stelick et al., 2021). Furthermore, the final product was enhanced based on the appearance of the breadsticks; these changed the color to golden brown in baking by considering the preference of consumers concerning the bake products outlined by Rainero et al. (2021). The technological attributes studied in the subject were water absorption and dough handling characteristics with regards to the breadsticks. Salacca seed flour incorporated in the wheat flour dough was found to increase water absorption because of the porous nature of the wheat flour dough, increased dough elasticity and extensibility. These compound are very important in achieving the right textural profile in baked foods because they define the ability of the dough to retain gases produced during fermentation and baking (Schmidt-Combest & Warren 2018). The present study also establishes that the addition of Salacca seed flour enhances the nutritional value both for the product as well as enhances the quality of dough and the end products.

Also technological factor especially in the area of mixing as well as baking in food processing has revolutionized quality of the products and the time taken to produce those products. This technological improvement is crucial in order to maintain quality in baked commodities at the same time as executing efficiency with respect to production processes (Talens et al., 2022). The introduction of such technologies enables one to actualization of the current and continuing trend of modern food competition that affirms new approach to enhancing the quality and safety of foods. In addition to nutritional and sensory changes, the incorporation of Salacca seed flour to breadsticks could be describe in terms of sustainability. Engaging in functional foods that consume Salacca seeds remained as waste or using other by-product shows a beneficial effect for food waste consumers want more healthy foods

(Rico et al., 2018). This system makes the many kinds of wastes generated during the product production useful in creating products of similar or higher value in the food industry, hence promoting a circular economy model.

To that we can also assign that the latter is very useful for health with regards to the fact that breadsticks can be crafted out of enriched Salacca seed flour. This may help contribute to gastrointestinal health, let alone the assumption of health gains whose primary outcome stems from the consumption of foods with polyunsaturated fatty acids and antioxidants that helps keep chronic diseases away (K. Ungureanu-Iuga & Mironeasa, 2021). These health benefits are highly useful for those companies considering that many consumers are now developing consciousness of what they are consuming with regards to their nutrients requirements and as such the products would be taken by the conscious health oriented consumers. In this respect, the conclusion part of this study also contributes to supporting researched done on the use of substitute flours in bread making. Previous studies also report that incorporation of other diverse by products such as grape pomace and brewer's spent grain enhanced nutritional and sensory attributes of bakery products (Lou et al., 2021). This research goes along this notion, that ingredient substitution provides an opportunity to introduce a new, different, more healthy ingredient into the formulation to suit the current diet and health-wise consumer.

In addition, attributes such as texture, taste, and appearance of the product have equal impact on the acceptance decisions made by the consumers. The additional positive comments arising from sensory analyses indicate that the use of Salacca seed flour is in tune with the nutritional suggestions and consumers' preferences of taste and texture (Amoriello et al., 2020). This aspect is incredibly valuable for the strategic selling of new products in highlyaturated food industry. Therefore, incorporation of Salacca seed flour at various percent replacements into breadstick is theoretically feasible in several aspects mainly in terms of nutritional quality, sensory characteristicstechnological functionality. The results also go further in showing the possible advantages of using different flours and by-products in the formation of more improved food products that should also be more nutritious and consumer attractive in the contemporary society (Nyhan et al., 2023). The same should be done further with a view to expanding the list of functional food products in this regard and also to provide empirical support to these findings with regard to other ingredient substitutions in various forms of baked goods.

Table 2: Comparative Analysis of Breadsticks with Salacca Seed Flour and Durio Graveolens (Durian dalit)

Feature	Breadsticks with Salacca Seed Flour and Durio Graveolens (Durian dalit)	Control Breadsticks
Nutritional Profile	Higher in starch, fiber, and essential fatty acids	Lower in nutritional value
Sensory Attributes	Distinct aroma and flavor, desirable crunchiness, golden-brown color	Less pronounced aroma and flavor, softer texture, pale color
Technological Properties	Improved dough elasticity and extensibility	Lower dough quality
Sustainability	Reduces food waste, promotes circular economy	Contributes to food waste
Health Benefits	Improved digestive health, potential cardiovascular benefits	Limited health benefits

Table 3: Comparative Analysis of Breadsticks with and Without Salacca Seed Flour

Parameter	Breadsticks with Salacca Seed Flour	Breadsticks Without Salacca Seed Flour
Nutritional Profile	Higher in starch, fiber, and essential fatty acids	Lower in starch, fiber, and essential fatty acids
Sensory Attributes	Distinct aroma and flavor, desirable crunchiness, golden-brown color	Less pronounced aroma and flavor, softer texture, pale color
Technological Properties	Higher water absorption capacity, improved dough elasticity and extensibility	Lower water absorption capacity, reduced dough elasticity and extensibility
Health Benefits	Improved digestive health, potential cardiovascular benefits	Limited health benefits
Sustainability	Contributes to reducing food waste, promotes a circular economy	May contribute to food waste
Consumer Appeal	Aligned with modern dietary preferences for healthier options	May not align with modern dietary preferences

DISCUSSION

=The use of Salacca seed flour and Durio Graveolens (Durian dalit) in breadsticks reveals a method of a new innovation in his line of enhancing nutraceutical and textural attributes of baked goods. The results presented in the present study can suggest that potential agriculturally derived ingredients can be added to foods and have both favourable effects on the environment and the health of individuals. There is the nutritional analysis which proves that the addition of the two ingredients increases the nutritional value of the breadstick and at the same time introduces flavors and textures to the breadsticks which have not been experienced before (Sato, 2023). Moreover, digital integration has emerged critical in addressing the equilibrium of the utilisation of the ingredients that are needed for the preparation of food products and in value addition. When it comes to flows in terms of production, the use of digital devices allows for corrections in real-time; the nutritional value of the nutrients that is input is retained by the procedure (Borodina et al., 2021). As a future direction of this study, the encouragement of the adoption of technology reformation will help enhance sustainable manufacturing systems in food business.

The formulation of the breadsticks using Salacca seed flour conjointly the Durio Graveolens (Durian dalit) is a completely new innovation within the field of food science and technology particularly in terms of content and palatability. Incorporation of these unused agricultural wastes helps serve the second upslash objectives of minimizing food wastage, and in the process, opens the flood gates to coming up with more healthful foods. Several studies suggest in this regard that Salacca seed flour consists of appreciable amount of dietary fiber and several nutrients which could further enhance the nutritional profile of bakery products (Matricano et al., 2021). Further, it creates new tastes and interlocking sensations , in particular the Durio Graveolens (Durian dalit) through which people can make healthy foods easily introduce to their diet (Zickafoose et al., 2022).

However, there is need to elaborate the sustainability component that is incorporated in this innovation. The use of Agricultural by products like Salacca seeds, Durio Graveolens (Durian dalit) was a morale boost to the current trend of combating food waste and encouraging sustainable food systems. From the perspective of the added value products, the agricultural food chain environment cost can be decreased by using these inputs (Krivonkia et al., 2022). This practicality is not only circular-oriented but goes further to support local agricultural utilization whereby each segment of the crop is utilised, leaving no segment of the resource unused. Consequently, similar innovation of all food products was postulated in this study asserting the possibility of sustainable food industry. Hence, other IT solutions are also useful as they are platforms where such innovative ingredients can be best integrated, into improving food production frameworks. That which can be tracked and modulated during production, these are principles that are especially valuable in the preservation of nutrients in the grains including Salacca seed flour and Durio Graveolens (Durian dalit) (Nathan et al., 2021). Propelling the use of big data and application of advanced automation methods it is possible to bring changes in the quality and standard of foods manufactured for the consumers (Paparoidamis & Tran, 2019). Food production technology is not only enriched by capabilities to increase production efficiency but also by a desire for other food products as it opens companies' possibilities to experiment.

More studies should also be conducted on the physicochemical characteristics and sensory attributes of the breadsticks made from Salacca seed flour and the Durio Graveolens (Durian dalit), and the other beneficial properties of flour in other foodstuffs. The freedom to develop other varied products that consumer may desire is therefore high and such can significantly impact on the market of healthy snacks (Kokotovich, et al., 2021). Additionally, the degree of integration of the underutilized ingredients into Food production shall be evaluated for its feasibility hence encouraging the use in the food chain (Hutahayan & Yufra, 2019). The understanding of the market as well as the acceptance of these products shall be useful to food manufactures who wish to create new and sustainable products. However, one component that distinguishes or determines consumer acceptance of innovative food products is behavioral consumer response. It has been established in the studies that customers are moving away from unhealthy products, and look for ESC (Environmentally Sustainable product) ("Market Structure and Consumer Behavior and Resilience for MSMES Agro-Food Industry in Malang City", 2023). It suggests that there is an urgent need for proper and attractive commercialization protocols for the full merits and worth of employed Salacca seed flour and a food made of two unique tropical fruits, Durio Graveolens (Durian dalit) for nutritional and environmental uses (Cuéllar-Gálvez et al., 2018). The consumers' interest can be secured by initiating informative campaigns in a bid to sway consumer test and subsequently subsequent consumers acceptance on these portfolio of food innovation products.

However, there is such opportunity for the interdisciplinary in food innovation which is one of the areas that should be considered. Fasten the food technologist in the agricultural and food chain in partnership with agriculturists will provide more angle to the product (Abdullah & Putit, 2023). This kind of partnership can lead to product innovation and development of new foods, which will be appealing to the consumers at the same time as it will address other societal call such as food desert and climate change as said by Rabadán (2021). Hence, both qualitative and quantitative methodological tools will be essential in the analysis of modern complexities of the food systems. It means that the food processors, policymakers, food transporters, and end-users, in general, should accept the innovative food production of Salacca seed flour and breadsticks with Durio Graveolens (Durian dalit) to be allied with the THREEWs philosophy. Then future expansion of the eating industry was attributed to the necessity to adopt such innovations to new conditions concerning the increasing population of the world as well as its need in the improved quality of food. The future research and collaboration will become the key to disclose the opportunities of these underutilized ingredients and encourage the proper application of these components in food products. More research should be directed toward understanding how all these innovations could be build on and to comprehending other products to

which they could be used. Some ideas that are now not explored are today; new formulation which may fit better to use by the consumers. Furthermore, it is an investigation of the probable efficacy of the application of organic agricultural by products to reductionist food production that can be considered sustainable.

CONCLUSION

Hence the utilization of Salacca seed flour and Durio Graveolens (Durian dalit) from the baked breadsticks may be a revolution toward enhanced nutritional and sensory qualities of the baked products. Therefore, the paper discusses the innovative underutilized agricultural by-product food solutions that can influence sustainability and health in the given aspect in general. Further, another aspect being the digital applications in the production facilities is another area in food production where the requirement of ingredients may be optimized as regards to quality raising. Thus, this study's result is meaningful to the food manufacturers who have dreams to come up with healthier foods that cater the market demands.

Therefore whereby the Salacca seed flour incorporated with the fruit find of Durio Graveolens (Durian dalit) in the processing of breadsticks can be counted as a revolution in the food processing technology and product development in general with highly emphasis on the nutritional and sensory quality enhancement of baked foods. The use of these ignored biomass resources enhances the nutritional value of the final products, and meets today's global sustainable standards of food production. Scientific work has revealed that it is possible to get a positive shift in Nutritional Value Added by replacing refining flours with F & S flours and get new flavors and textures which acceptability in a consumer Market:- (Gómez & Martínez, 2017). This strategy is well underlined by the fact that there has been growing concern with the quality of food that is consumed especially where it is not 'sacrificed' for the sake of health is concerned.

Also, the result of this research provides understanding of how such change may be utilized to enhance the production of foods. The progressing technologies can also improve the effectiveness of application of the crude materials and raise the quality of the product as well as solving the consumer needs that are a challenge to the food producers. For example: With the help of DIS & MAS and computerized learning, ingredient reactions as well as baking processes could be analyzed and improved hence enhancing homogeneity and quality of cake (Wang et al., 2020). This is equally cardinal for [the food industries to] embrace this integration as the market evolves and customers start demanding more natural and healthier food produce. Another thing important to add that a Salacca seed and Durio Graveolens (Durian dalit) can have a cooperative in the process of improving human nutrition something considered as a positive moment in the development of new foods. This research has created room for added value in the efficient removal of the wastes in the agricultural sector, and therefore in the foods sub-sector by utilizing the by-products in makeup of those aforementioned successful products. The incorporation of such ingredients also implies virtually no food loss and it positively impacts the local environment and agriculture (Hernández-López, 2023). This is in line with other approaches that are being used in the world in the efforts to decrease the impacts on the environment when producing food.

However, the sensory analysis of the breadsticks as proposed by this study shows that the incorporation of Salacca seed flour and Durio Graveolens (Durian dalit) does not effect the quality of the resultant product.

On the other hand, the distinct tastes and mouth feel $\frac{1}{2}$ which these ingredients bring to food products could be value-adds that consumers will find appealing and thus making the product more marketable (Gómez & Martínez, 2017) For example, oddities such as banana in bread and laurel in language could be peculiar tastes which could enhance the characteristics of food products in a way that

consumers would be willing to pay a premium. This finding fits well in a competitive food market system where the consumer sensory attributes work as push factors to consumption. The most important aspect of food innovation is to have the capability to combine healthy foods in tasty meals. In addition, the results of the present study suggest the possible need for examining other potential substitutes in baked products. This may partly contribute to the increases in the level of health consciousness and environmental concern where operationalization of functional foods is anticipated to attract relatively higher demand. This serves a good opportunity for the food industries to diversify their products through the addition of the following hidden gem local ingredients; Salacca seed flour and Durio Graveolens popular known as Durian dalit since they are rich in bioactive compounds and nutrients as supported by Martins et al., (2020). This has, therefore, called for enhanced research on the way that formulations and processing methods can be altered in order to extract higher nutritional and sensing characteristics about these specialty products.

Last but not the least, the conclusion of the proposed work will be useful for policy-wise and educative to increase application of underutilized foods in production. Other stakeholders within the food industry can create awareness of the advantages of using such ingredients that will foster the adoption of better and sustainable ingredients that will respond positively to consumer satisfactions. More so, such food manufactures, researchers, and policymakers will try to actualize this agenda, which in the long run, transforms the food system into a healthier and sustainable one (Gómez & Martínez, 2017).

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