The development of instant (dried) sago noodles fortified with functional components

To cite this article: Dewita et al 2019 IOP Conf. Ser.: Earth Environ. Sci. 253 012018

View the article online for updates and enhancements.
The development of instant (dried) sago noodles fortified with functional components

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Abstract. Sago is a major plantation crop in the Meranti, Indragiri Hilir and Bengkalis regions of Riau Province, Indonesia. Sago may be substituted for rice as an alternative staple food in this area, in particular in form of traditional fresh noodles, locally called wet noodles. This product is rich in carbohydrates but it has a low protein content. Therefore, it is important to improve the nutritional value of sago noodles. This study aimed to process wet sago noodles into instant (dried) noodles fortified with functional food components (fish protein concentrate, fish oil, vitamins and total fibre) using various formulations through the addition of anchovy and shrimp concentrates as well as fermented angkak rice (red yeast rice) and katu (Sauropus androgynus) leaves. Sago noodle quality was evaluated through organoleptic tests and proximate composition analysis. The data obtained were homogenized, then tabulated and analysed descriptively. The results showed that the majority of organoleptic panellists (77-83 %) liked sago noodles fortified with functional food components. In addition, fortification with functional components had a significantly effect on sago noodle protein content, which was higher (around 8-9 %) compared to the unfortified control (3.07 %), and fulfilled the Indonesian national standard (SNI) minimum requirement of 8%.

1. Introduction
The main carbohydrate food consumed by the Indonesian population is rice. The limited supply of rice has become a major national problem, as Indonesia still needs to import rice. Although Indonesia is rich in alternate carbohydrate food resources such as tubers, bananas and sago, these are in generally not fully optimised to fulfill the nutritional needs of the population. Sago is one potential source of carbohydrate which is abundant in certain areas of Indonesia, therefore the use of sago as a rice substitute could be developed as an alternative food source for the population and as a source of raw materials for the food industry.

Meranti Islands District, in Riau Province, is one area in Indonesia with particularly extensive sago palm plantations, covering around 38,163 Ha. This area is approximately 2.98 % of sago palm plantations nationwide. Sago is a major source of food and income for the local people in Meranti [1]. In addition to traditional uses, local people now use sago flour as a raw material to produce a local food product marketed as Sago Strip sago noodle products.

However, the development of this local food product has been slow, especially due to the appearance and nutritional value. This situation points to a need for innovation to transform this local food product into a superior, more marketable product. This could be achieved through fortification of the noodles with functional food components, using a similar approach to a previous study finding that street food products fortified with catfish concentrate were carbohydrate-rich (23.82 %) and protein-
rich (49.8 %) [2]. Another study conducted showed that cookies could be successfully fortified using Chlorella sp extract [3].

The Meranti area of Riau Province is also rich in fisheries commodities. This begs the question as to how such potential could be utilized to the maximum extent possible to support local food security. One partial answer could be the development of wet sago noodle products fortified with functional food components of such as protein rich fish concentrate, and omega-9 rich fish oil. In addition, vitamin-rich vegetable products (e.g. spinach and carrots), and fibre-rich microalgae could be incorporated. A further development would be to process the fresh (wet) noodles to an instant (dry) form with attractive packaging, both for longevity and to attract consumers. The development of this wet sago noodle product, in addition to increasing the nutritional value, could also support the national policy on food consumption diversification, especially the search for rice substitutes.

Based on the above situation, it was decided to develop a processing technology for transforming wet sago noodles into instant (dried) sago noodles fortified with functional food components. The purpose of this study was to process a sago-based local food (sago noodles), fortifying the product with various formulations containing functional food components (fish protein concentrate, fish oil, vitamins and total fibre), and to analyse the quality of the end product through organoleptic tests and determination of the proximate composition.

2. Materials and Methods

This research used an experimental research approach to process wet sago noodles into instant sago noodle fortified with functional components of food. The added ingredients included in the formulations included anchovy and shrimp concentrate (flour), fish oil and natural coloured vegetable ingredients as source of vitamins and fibre. The vegetable components used were red yeast rice (local name angkak) and the leaves of Sauropus androgynous (local name katu). The four fortified formulations and control sago noodle components are described in Table 1.

Table 1. Formulation of fortified and control sago noodles

| Component           | Sago anchovy noodles (gr) | Sago shrimp noodles (gr) | Control (gr) |
|---------------------|---------------------------|--------------------------|--------------|
|                     | angkak | katu | angkak | katu | angkak | katu |
| Sago starch flour   | %      | 100  | 100    | 100  | 100    | 100  |
| Anchovy concentrate  | %      | 10   | 10     | 0    | 0      | 0    |
| Shrimp concentrate   | %      | 0    | 0      | 10   | 10     | 0    |
| Fish oil            | %      | 5    | 5      | 5    | 5      | 5    |

The quality of the sago noodle products produced was evaluated through organoleptic tests and analysis of the proximate composition. The organoleptic test panellists evaluated the noodles for colour, odour and texture using the following hedonic scale: dislike (3), somewhat dislike (5), like (7) and strongly like (9). Sago noodles were served without any additional seasonings or preservatives. Panellists for the organoleptic tests were 80 students in the Department of Fisheries Products Technology, University of Riau. The proximate composition analysis determined water, ash, protein, fat and carbohydrate content, according to AOAC protocols [4].

3. Results and Discussion

3.1. Organoleptic analysis

The organoleptic tests using the four-point hedonic scale (Table 2) showed that the fortified noodles were considered acceptable whether the sago noodles were fortified with functional food components form anchovies or prawns. The natural dyes contained in angkak and katu were important, as panellist
response was strongly determined by the colour parameter, as well as the odour and textures of the sago noodles served.

Table 2. Percentage (%) panellist responses in hedonic organoleptic tests on sago noodles with fortified (added functional food components) and original (control) formulations

| Organoleptic scale | Sago anchovy noodles | Sago shrimp noodles | Control (original) |
|--------------------|----------------------|---------------------|-------------------|
|                    | angkak | katu | angkak | katu |         |
| Strongly like | %  | 15   | 10   | 17   | 10  | 10         |
| Like              | %    | 80   | 77   | 83   | 82  | 80         |
| Somewhat dislike  | %    | 5    | 10   | 0    | 3   | 5          |
| Dislike           | %    | 0    | 3    | 0    | 2   | 5          |

Colour is a very important component in determining the quality or degree of acceptance of a food product, as an attractive colour can determine the degree of acceptance or fondness. If the colour gives the impression that the food is not attractive or has deviated from the colour that the consumer feels it should have, then the consumer will tend to reject it. The panellist response at the time of organoleptic test showed that the sago noodles that were coloured were more interesting than the original sago noodles that were white to gray and appeared dull. The visual sense has been confirmed as one of the more effective tools of foraging and predicting foods which are more nutritious to eat [5].

Texture is also a parameter which can determine product selection. From the results of this research, panellists generally like the texture of sago noodles, both the original (control) sago noodles and fortified sago noodles. Together with colour, texture and material consistency can affect the perceived taste of a material [6].

Odour is also an important factor in determining the level of consumer acceptance of a product, because before eating the consumers usually first smell the product to judge whether or not the product is appropriate to be eaten. A delicious smell can attract the attention of consumers, because consumers are more likely to like the food from which the attractive odour originated [7]. When the organoleptic test panellists were asked to respond to the sago noodles presented, it turned out that the panellists preferred the smell of sago noodles fortified with functional food components to that of the original sago noodles. The aroma and taste relationship work together to form the perceived nature of the aroma and taste of the food [8].

3.2. Proximate analysis

The proximate composition analysis (%) of sago noodles fortified with functional components of food and original noodles included the water, ash, fat, protein, total fibre and carbohydrate content. The results (Table 3) show that sago noodles fortified with functional food components had a higher protein content than the control (original product).

Table 3. Proximate composition (%) of original (control) and fortified sago noodles

| Proximate component | Sago anchovy noodles | Sago shrimp noodles | Control (original) |
|---------------------|----------------------|---------------------|-------------------|
|                     | angkak | katu | angkak | katu |         |
| Moisture            | 12.17  | 12.17 | 10.54  | 10.96 | 10.30   |
| Ash                 | 2.37   | 2.08  | 1.25   | 1.40  | 0.10    |
| Fat                 | 0.51   | 0.45  | 0.64   | 0.57  | 0.20    |
| Protein             | 9.52   | 8.45  | 8.48   | 7.55  | 3.07    |
| Fibre               | 2.27   | 1.99  | 2.05   | 1.83  | 1.65    |
| Carbohydrate        | 87.50  | 76.85 | 77.04  | 77.69 | 84.68   |

The results in Table 3 show that the fortification of sago noodles with functional food components from either fish or shrimp concentrates can raise the protein content. This is similar to the increased
protein content of crackers fortified with shrimp shell powder. By adding 5 % to 20 % of shrimp shell powder, protein content in crackers was increased 2-4 times compared to a control treatment [9]. Moreover, addition of 3-10 % of shrimp shell powder in croquettes has been found to enrich protein levels to 2-3 times the level in unfortified croquettes [10]. As for shrimp shell powder, foods fortified with fish powder can be significantly enriched in protein [11].

The protein content of all the fortified instant sago noodles complies with the Indonesian national standard SNI 01-2974-1992 minimum requirement of 8% protein. To further increase the protein content, future formulations might be combined with the addition of vegetable protein sources such as corn and soybeans, as animal and vegetable proteins can complement each other in terms of amino acid content. Seafood such as fish and shrimp contain high levels of essential amino acids. The results of the analysis of essential amino acid composition of the sago noodles fortified with the functional food components and the original unfortified noodles are shown in Table 4.

Table 4. Essential amino acid profile of fortified and unfortified sago noodles

| Essential amino acid profile (%) | Sago anchovy noodles | Sago shrimp noodles | Control |
|----------------------------------|----------------------|---------------------|---------|
|                                  | angkak | katu | angkak | katu | |
| Histidine                        | 0.06   | 0.14 | 0.16   | 0.18 | 0.11 |
| Threonine                        | 0.17   | 0.35 | 0.47   | 0.43 | 0.26 |
| Tyrosine                         | 0.22   | 0.19 | 0.32   | 0.33 | 0.14 |
| Methionine                       | 0.16   | 0.17 | 0.26   | 0.22 | 0.12 |
| Valine                           | 0.48   | 0.44 | 0.48   | 0.56 | 0.26 |
| phenylalanine                    | 0.37   | 0.29 | 0.57   | 0.52 | 0.24 |
| Isoleucine                       | 0.48   | 0.42 | 0.68   | 0.61 | 0.25 |
| Leusine                          | 0.66   | 0.58 | 0.86   | 0.81 | 0.44 |
| Lysine                           | 0.54   | 0.46 | 0.54   | 0.53 | 0.36 |
| Total                            | 3.14   | 3.04 | 4.34   | 3.67 | 2.18 |

The essential amino acid profiles of sago noodles (Table 4) show that the total amino acid content of original sago noodles (control) is lower than that of the sago noodles fortified with functional food components. In addition, the total amino acid content of sago shrimp noodles with angkak colouring had the highest concentration among the fortified sago noodle treatments. Angkak is known not only as a natural pigment but also as a nutritive food, high in monounsaturated fatty acids, plant sterols, isoflavones, isoflavone glycosides, as well as minerals like zinc and selenium [12]. For example, the addition of angkak to low fat yogurt resulted in 3.12 % protein content, thus meeting the SNI standard for yogurt products [13].

4. Conclusion

The functional food components (anchovy and shrimp concentrates) combined with the natural dyes angkak (red yeast rice) and katu (Sauropus androgynous) leaves, were used as ingredients in fortified sago noodles. The instant sago noodle products contained 7.55% – 9.52% protein, higher that the original sago noodles (3.07%). Based on the essential amino acid profile of the fortified instant sago noodles, the fish and shrimp concentrates produced an increase in total amino acid content, which dominated by essential amino acids. Differences in the composition of the ingredients used in the manufacture of fortified instant sago noodles can cause differences in the essential amino acid profile of between fortified sago noodle products as well as compared to the original (unfortified) product.
Produk Makanan Jajanan Berbahan Baku Konsentrat Protein Ikan Baung (Hemibagrus Nemurus) Di Kabupaten Kampar, Riau J. Pengolah. Has. Perikan. Indones. 15 216–222

[3] Dewita, Syahrul, and Desmelati Functional Characteristics of Cookies Containing Snakehead (Ophiocephalus striatus) Fish 2018 Protein Concentrate Fortified with Chlorella sp Int. J. Oceans Oceanogr.12 43–52

[4] AOAC 2007 Official Methods of Analysis of AOAC International, 18th ed., vol I and II (Gaithersburg: Association of Official Analytical chemists)

[5] Spence C, Okajima K, Cheok A, Petit O and Michel C 2016 Eating with our eyes: From visual hunger to digital satiation Brain. Cogn. 110 53–63

[6] Okajima K and Spence C 2011 Effects of Visual Food Texture on Taste Perception Percept. 2 966-966

[7] Winarno F 2002 Kimia Pangan dan Gizi (Jakarta: Gramedia)

[8] Tournier C, Sulmont-Rosse C and Guichard E 2007 Flavour perception: aroma, taste and texture interaction Food 1 246–257

[9] Khan M and Nowsad A 2012 Development of protein enriched shrimp crackers from shrimp shell wastes J. Bangladesh. Agril. Univ. 10 367–374

[10] Khan M, Rahman M L, Rahman M L and Alam A N 2013 Development of protein enriched shrimp croquette from shrimp industry wastes J. Bangladesh. Agril. Univ. 11 331–340

[11] Shaviklo A R 2015 Development of fish protein powder as an ingredient for food applications: a review J. Food Sci. Technol. 52 648–661

[12] Musselman M E, Pettit R S and Derenski K L A 2012 Review and Update of Red Yeast Rice J. Evid.-Based Complement. Altern. Med. 17 33–39

[13] Romulo A, Suliantari and Palupi N 2017 Application of Angkak (Red Yeast Rice) Extract as Natural Red Colorant in Making of Low Fat Fruity Probiotic Yoghurt EC. Nutr. 7 203–209