EVALUATION OF CONSUMER ACCEPTANCE OF COOKIES ADDED WITH MODIFIED MICROWAVE BUSIL (*Xanthosoma sagittifolium* L.) STARCH

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Abstract

Busil (Xanthosoma sagittifolium (L.) Schot) and modified cassava flour (mocaf) are two of the local agricultural products from Banjarnegara. The utilization of busil is generally limited to primary processing only. Similar conditions also occur in mocaf, where the utilization of mocaf as a food ingredient is still limited. Conversely, wheat flour frequently serves as the primary raw material in cookie production. This study aims to assess customer acceptance of cookies produced with added microwaved-modified busil starch (1 W/g; 7 min). The consumer approval evaluation was conducted on three variants of cookies: cookies without added busil starch (MF), cookies with native busil starch (NB), and cookies with microwave-modified busil starch (B3). Microwave-modified busil starch in mocaf-based cookie production requires additional development, as it has not yet led to a notable increase in customer acceptance.

Keywords: *busil, starch, mocaf, cookies, customer acceptance, microwave, Banjarnegara.*

A. Introduction

Busil (*Xanthosoma sagittifolium* (L.) Schot), also known in some locations as keladi, talas belitung, or kimpul, is one of the local food potentials of Banjarnegara Regency (Bupati Banjarnegara, 2018). Busil from Banjarnegara has unique characteristics, particularly in the significantly greater tuber size. Busil-based products produced in Banjarnegara often still use fresh busil as their primary ingredient (Hakim et al., 2021). No culinary products that use busil starch as their ingredient have been found. *Xanthosoma* starch is known to have several characteristic advantages, such as strong flexibility and small granule size, which will generate a soft and readily digested texture (Aryanti et al., 2017). This circumstance opens up the possibility of using busil starch in numerous food products, including cookies.

Cookies are a sort of biscuit produced from a soft, crispy dough with a less thick structure. (Badan Standardisasi Nasional, 2018). Wheat flour often remains the primary raw material in cookie making. However, the development of gluten-free products opens up the potential for using modified cassava flour (mocaf) in cookies. In addition to being gluten-free, mocaf also possesses high rheological qualities, rehydration capacity, and solubility (Raya et al., 2024). The availability of mocaf from the local industry in Banjarnegara has also started to develop, and mocaf has been manufactured up to 1-5 tons per month (Widodo, 2023). However, there are issues with utilizing mocaf in cookies, such as the texture of the cookies being coarse and overly crumbly. The aftertaste of cookies prepared with 100% mocaf also causes a dry sensation in the mouth (Rosida et al., 2020). The addition of busil starch is regarded to have the potential to retain the cohesion and stability of the cookies.

Starch can naturally be directly added to cookie formulations; however, there are characteristics of natural starch that are generally considered less advantageous when applied to cookies, such as high viscosity during processing, susceptibility to damage due to high temperatures, and instability of the gel formed during cooling or storage (Hakim et al., 2022). Suppose natural busil starch is directly utilized in cookie production. In that case, it can make the cookies brittle and the dough molding and baking processes less efficient due to low dough stability and high energy requirements. Modified starch is thought to be the most suitable remedy for this problem. Previous research has shown that modified starch has better characteristics than natural ones. Research on starch modification technology has also been developed to be efficient, cost-effective, environmentally friendly, and stable. (Li et al., 2020; Maniglia et al., 2021; Sui & Kong, 2018). The starch modification technique deemed capable of addressing this is a physical starch modification, one of which involves using microwave irradiation.

B. Literature Review and Hypothesis Development

Research on the diversification of busil in the form of flour or starch has been widely applied to food products, for example, in analog rice (Noviasari et al., 2022), noodles (Rosida et al., 2022), getuk (Rahmawati et al., 2023), cookies (Salsabil et al., 2023), Palembang pempek (Yunierlita et al., 2023), and pukis (Elu et al., 2023). Research studies have shown that busil has the potential to be applied to various processed food products. Busil starch is considered a suitable alternative to the production of mocaf-based cookies. Several previous studies have shown that adding starch to cookies or biscuits can facilitate dough molding, resulting in a crunchier texture that is not easily crumbled (Indrianti et al., 2021). However, no studies have been found on using busil originating from Banjarnegara. Banjarnegara's busil starch exhibits a comparable circumstance; however, there is still a scarcity of research on its potential applications in food products.

Previous studies on starch modification also show that modified starch can produce good yield and product characteristics, short processing time, homogeneous modification process, guaranteed product safety, and easy handling and equipment maintenance (Aulia Arifin et al., 2024). Concerning cookies, microwave irradiation is expected to reduce amylopectin and increase amylose in starch, producing a firmer yet crispy cookie texture and better paste stability. The principle of microwave irradiation technology in starch modification is based on the dielectric heating and electromagnetic polarization of the hydroxyl groups present in the structure of water and starch. The rearrangement of starch molecules is subsequently initiated by breaking glycosidic bonds by microwave irradiation of starch. This has implications for granules' morphology and starch's crystallinity, ultimately leading to changes in viscosity, swelling, and emulsifier stability. The intermolecular structure of starch is altered, resulting in changes in water binding capacity, solubility, swelling power, gelatinization mechanism, syneresis, and starch's thermal and rheological properties (Zhong et al., 2019).

Microwave irradiation of native busil starch is expected to produce modified busil starch with a higher amylose content. When applied to cookies, this condition can produce a texture that is not easily broken but remains crumbly and easy to consume. Producers and cookie consumers are expected to like this condition because it can reduce damage to cookies, especially during the packaging and distribution process. Adding modified starch is also considered not to reduce the taste quality of the resulting cookies.

C. Research Method

The production of cookies in this research is based on Ervina (2023) With some modifications. The primary component of the cookies is modified cassava flour (mocaf), supplemented by 12% busil starch. In the interim, the consumer acceptance evaluation was conducted on three distinct varieties of cookies: cookies without adding busil starch (MF), cookies with native busil starch (NB), and cookies with microwave-modified busil starch (1 W/g; 7 min; B3). Preference consumer tests were administered to 50 non-allergic respondents who favored goods containing powdered milk. The evaluated sensory characteristics encompass aroma, hardness, softness, taste, and overall preference. The evaluation uses a scale from 1 to 5, namely (1) immensely dislike, (2) dislike, (3) somewhat like, (4) like, (5) very like. SPSS v.24 (IBM Corp., Armonk, NY, USA) was used for the statistical evaluation. One-way analysis of variance (ANOVA) and Duncan's multiple range test were utilized to examine the variations among the samples. The significant difference between groups was set at $p < 0.05$. A principal component analysis was also applied using XLSTAT Premium Trial v.2024 (Addinsoft, New York, USA) to summarize the relationship between cookie formulation and consumer preferences.

D. Discussion

Microwave irradiation of native busil starch is known to cause an increase in amylose content and decrease amylopectin content, as previously as previously conducted research. Amylopectin from microwave-modified busil starch decreases from 80,12% to 56,82% (Hakim et al., 2022). Overall, consumer acceptance of the quality attributes of the busil starch cookies samples is almost "liked" (Tabel 1). Quantitatively, consumer acceptance is even higher than mocaf cookies without the addition of busil starch. However, statistical tests indicate that the differences among the cookie samples are not significant, suggesting that the modified busil starch resulting from microwave irradiation still needs further development when applied to cookies.

Table 1. Cookies consumer acceptance

Sample	Aroma	Hardness	Softness	Taste	Overall
MF	3.50 ± 0.93^a	3.50 ± 0.68^a	3.66 ± 0.74^a	3.34 ± 0.85^a	3.52 ± 0.81^a
NB	3.56 ± 0.88^a	3.58 ± 0.76^a	3.54 ± 0.73^a	3.38 ± 0.92^a	3.45 ± 0.88^a
B3	$3.68\pm0,71^a$	3.62 ± 0.83^a	3.76 ± 0.85^a	3.74 ± 0.63^b	3.68 ± 0.79^a

Values with different superscripts within the same column are significantly different ($p<0.05$) among the variations. MF: cookies without adding busil starch, NB: cookies with native busil starch, B3: cookies with microwave-modified busil starch (1 W/g; 7 min)

Referring to the PCA visualization (Figure 4), it can be determined that to obtain cookies with a good overall rating; the cookies must have high levels of taste, aroma, hardness, softness, and amylose content and, conversely, low levels of amylopectin content (Figure 4A). Furthermore, it is also known that the three cookie variants (MF, NB, and B3) each have their own distinct characteristics. The parameters of hardness, aroma, taste, overall softness, and amylose content positively correlated with the acceptance of the B3 cookie characteristics, which received the highest ratings from consumers. (Figure 4B)

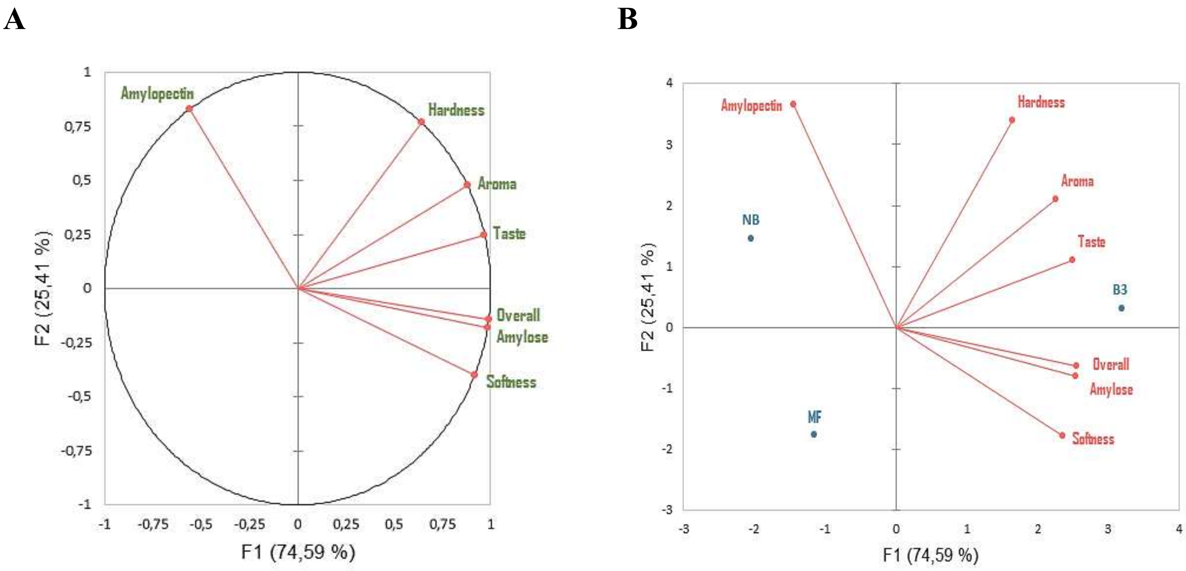

Fig. 1. PCA of cookies formulation and cookies consumer acceptance. A: projection of variables, B: projection of samples and variables. MF: cookies without adding busil starch, NB: cookies with native busil starch, B3: cookies with microwave-modified busil starch (1 W/g; 7 min)

E. Conclusion

Based on the research results, it can be concluded that modifying busil starch with microwave irradiation can reduce the amylopectin content. However, microwave-modified busil starch in the production of mocaf-based cookies still needs further development because it has not yet significantly improved consumer acceptance and remains at a favorable rating.

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