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SCRAP: FAVOURING FROM SHRIMP WASTE (LITOPENAEUS VANNAMEI) AS A SUBSTITUTE FOR MONOSODIUM GLUTAMATE (MSG) TO PREVENT STUNTING IN TODDLERS

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ABSTRACT

Monosodium glutamate (MSG) is widely used as a flavor enhancer but excessive consumption in early childhood has been associated with neurotoxic effects that may impair cognitive development and contribute indirectly to stunting. This study aims to develop SCRAP, a natural seasoning produced from *Litopenaeus vannamei* shrimp waste, as a nutritious and sustainable substitute for conventional MSG. Shrimp waste was selected because it contains natural glutamic acid, protein, calcium, and phosphorus that support children's growth while reducing organic waste. The research employed proximate analysis to determine nutritional composition and organoleptic testing to evaluate sensory acceptance compared with conventional MSG. Proximate analysis showed that SCRAP contained 3.63% moisture, 43.16% ash, 12.63% protein, 15.62% fat, 24.96% carbohydrates, and 290.99 kcal/100 g. Organoleptic evaluation demonstrated mean scores of 3.81 for taste, 3.95 for aroma, 3.76 for appearance, and 3.43 for texture. Compared with conventional MSG, SCRAP received higher consumer acceptance for taste, aroma, and appearance, while texture showed comparable acceptance. These findings indicate that SCRAP is a safe, nutritious, and environmentally friendly natural seasoning with the potential to replace conventional MSG. Its nutritional value and favorable sensory characteristics suggest that SCRAP can support healthier dietary practices for toddlers while contributing to stunting prevention and sustainable food production.

Keywords: monosodium glutamate (MSG); stunting; health effect; natural flavorings; shrimp waste; alternative seasoning.

INTRODUCTION

Monosodium glutamate (MSG) is a sodium salt compound of glutamic acid, one of the non- essential amino acids widely found naturally in food ingredients such as meat, vegetables, and fermented products (Kazmi et al., 2017). Glutamic acid is the main component responsible for the umami taste, which is now internationally recognized as the fifth basic taste after sweet, salty, sour, and bitter (Kurihara, 2015; Roper, 2017). Glutamic acid (a non-essential amino acid) is a naturally occurring amino acid that can be synthesized in the body as a central component of proteins (Fadila et al., 2023).

Although it enhances flavor, MSG is often used excessively. Based on bibliometric analysis, toddlers in Indonesia can consume MSG up to 0.06 kg or 60 grams daily, far exceeding the recommended safe limit of 0–120 mg/kg body weight per day (Widjayatri et al., 2020). This intake comes from main meals and various instant snacks, school snacks, and artificially sweetened beverages.

The impact of excessive MSG consumption in children is severe. MSG is known to increase impulse activity in the brain to an extreme level, causing excitotoxicity, a condition in which neurons are overstimulated to cell death (Rochmah & Utami, 2022). Children who frequently consume foods containing MSG are at risk of experiencing brain cell damage, which can reduce thinking ability and memory capacity and cause impairments in cognitive development (Widjayatri et al., 2020).

According to the World Health Organization (WHO), toddlers aged 1–3 years require an average daily energy intake of approximately 1,000–1,300 kilocalories. This should be distributed across 45– 60% carbohydrates, 10–15% protein, and 25–35% fat to support balanced growth and development. In addition, adequate intake of micronutrients is critical, including iron (7 mg/day), calcium (500 mg/day), zinc (3 mg/day), vitamin A (400 µg/day), and vitamin D (600 IU/day), which play essential roles in bone formation, immune defense, and cognitive development (WHO, 2 020; WHO/FAO, 2004). Indonesia's Angka Kecukupan Gizi (AKG) provides similar recommendations tailored to toddlers within the same age group. National guidelines specify a daily requirement of 1,125 kilocalories, supported by 26 grams of protein, 44 grams of fat, and 155 grams of carbohydrates. In addition, toddlers should receive sufficient levels of micronutrients including calcium (650 mg/day), iron (8 mg/day), vitamin A (400 µg/day), vitamin C (40 mg/day), vitamin D (15 µg/day), and zinc (3 mg/day). These recommendations highlight the importance of ensuring a nutrient-dense and varied nutritional plan to adequately support toddlers physical and cognitive development (Kementerian Kesehatan RI, 2019).

One of the long-term consequences of these developmental disorders is stunting, a condition of growth failure in toddlers caused by chronic malnutrition, particularly during the golden period of the First 1000 Days of Life (Yusran, 2023). Stunting causes short stature in children, profoundly impacting brain function, learning ability, future productivity, and the risk of non-communicable diseases in adulthood (Paramashanti et al., 2016). If not addressed early, the effects of stunting can lead to irreversible developmental delays, contributing to lifelong physical and cognitive impairments. These children may struggle with academic achievement, limiting their social and economic opportunities in adulthood. Furthermore, the risk of chronic diseases such as hypertension, heart disease, and diabetes increases in stunted individuals, exacerbating the burden on healthcare systems and contributing to a cycle of poverty and poor health that can persist across generations (Black et al., 2013).

The severe health impacts caused by stunting are in contradiction to Sustainable Development Goal (SDG) 3 about Good Health and Well-Being, which emphasizes ensuring healthy lives and promoting well- being for all people at all ages. This goal has specific targets directly related to the issue of stunting, such as Target 3.2, which aims to end preventable deaths of newborns and children under five, and Target 3.4, which focuses on reducing premature mortality and promoting healthier lives (Sweileh, 2020).

In 2024, Indonesia saw a positive change in the rate of stunting, with a notable drop from 21.5% in 2023 to 19.8%, as reported by the Survei Status Gizi Indonesia (SSGI) from the Ministry of Health (Badan Kebijakan Pembangunan Kesehatan, 2024). This is a significant milestone, as it is the first time the national stunting rate has gone below 20%, meeting and surpassing the national goal of 20.1% and matching the standards set by the World Health Organization (WHO, 2018). The reduction of 1.7 percentage points has helped prevent around 357,000 to 377,000 children under five from developing stunting, which is more than the annual prevention target outlined in the Rencana Pembangunan Jangka Menengah Nasional (Bappenas, 2019).

Meeting the nutritional needs must be a top priority as a step toward reducing stunting rates among toddlers in Indonesia. These efforts contribute to the success of Sustainable Development Goal (SDG) 2 about Zero Hunger, which aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture. This goal has two related targets: Target 2.1 emphasizes the importance of ensuring access for everyone (including infants and vulnerable groups) to safe, nutritious, and sufficient food throughout the year, while Target 2.2 aims to end all forms of malnutrition, including reducing stunting in children under five, which has been internationally agreed upon (Sporchia et al., 2024).

Macronutrients such as protein, carbohydrates, and fats, as well as micronutrients such as calcium, play a vital role in supporting children's optimal growth and development. Studies show that toddlers with low protein, fat, and carbohydrate intake have a 1.7 times higher risk of experiencing stunting compared to those with adequate intake (Sari et al., 2016). Calcium also plays a role in bone growth and height, and supports overall body metabolism (Azmy & Mundiastuti, 2018). In addition to meeting nutritional needs, it is also essential to maintain a balanced nutritional plan. Providing healthy, nutritious, and safe complementary foods to breast milk is necessary to meet children's nutritional requirements, especially during the transition from breastfeeding to family foods (Ummah et al., 2020). Ensuring proper nutrition continues to be a key strategy that needs to be effectively managed in order to meet the 2025 target of reducing stunting by 18.8%.

In the effort to find a healthier alternative to MSG that also supports children's nutritional needs, shrimp waste (Litopenaeus vannamei) has emerged as a potential solution. Shrimp waste, such as head and shell, contains natural glutamate, protein, calcium carbonate, and carotenoids like astaxanthin, which act as powerful antioxidants and boost the immune system (Muzzarelli & Joles, 2000). Specifically, the nutritional content of shrimp waste supports children's essential nutrition needs, including: crude protein of 25–40%, which is needed for the formation of cells, body tissues, and digestive enzymes (Muzzarelli & Joles, 2000); calcium carbonate up to 45– 50%, which is crucial in the process of bone mineralization and the growth of children's height (Muzzarelli & Joles, 2000); carotenoids such as astaxanthin, which have strong antioxidant properties, capable of strengthening the immune system and preventing cell damage caused by free radicals (Hu et al., 2019); and natural glutamate, as a source of natural umami taste that does not cause the neurotoxic side effects associated with synthetic MSG.

This waste can be transformed through proper processing innovation into a natural seasoning product called SCRAP, which has a savory and umami taste similar to MSG but is safer, more nutritious, and environmentally friendly. SCRAP is made from Litopenaeus vannamei shrimp waste, a byproduct rich in glutamic acid, protein, calcium, and phosphorus, offering functional nutritional potential. As the United Nations (2015) emphasized, achieving Sustainable Development Goal (SDG) 12 about Responsible Consumption and Production requires ensuring sustainable consumption and production patterns. By utilizing shrimp waste such as head, shell, and tail as raw material, SCRAP embodies this goal through zero- waste practices and sustainable food innovation. It also functions as a seasoning and a nutritional effort to support healthy eating patterns and prevent stunting among Indonesian toddlers. This product offers new hope in fulfilling the need for flavor without compromising both human health and the environment for future generations.

Problem Statement

1. What is the production process of SCRAP so that it can be used as a substitute for MSG for early toddlers?
2. What nutritional contents are in SCRAP, and how well does it meet children's nutrition plans to prevent stunting?
3. Can consumers accept SCRAP as a safe alternative flavor enhancer to replace MSG for early toddlers?

Research Objectives

1. To understand and explain the SCRAP production process so that it can be used as a substitute for MSG in early childhood.
2. To analyze the nutritional content in SCRAP and evaluate its suitability for children's nutrition plans to prevent stunting.
3. To test the level of consumer acceptance of SCRAP and assess whether SCRAP can be used as a safe alternative seasoning to replace MSG for early childhood consumption.

METHOD

Materials and Tools

The ingredients we use to make SCRAP are as follows:

Table 1. Composition of SCRAP

No.	Composition	Quantity (g)
1	Shrimp waste	265
2	Garlic	101
3	Sugar	92
4	Salt	70
Total		**528**

The following tools and equipment are used in the preparation process: (1) Blender, (2) Wok, (3) Stove, (4) Knife, (5) Spatula, (6) Strainer, and (7) Cutting board.

Manufacturing Procedure

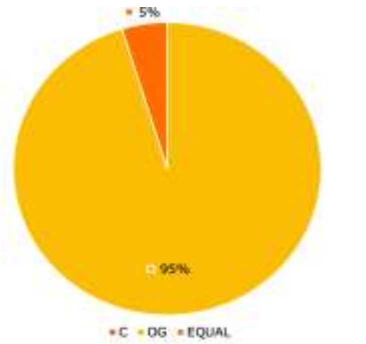
The process for making this product is as follows: First, wash and drain the shrimp dregs. Then, thinly slice the shrimp dregs (skin, head, tail) and garlic, then roast until dry. Blend the ingredients until smooth and add sugar and salt. After that, repeat the roasting and smoothing process using a blender until the ingredients become a fine powder.

Method

The methods used in this research include survey and experimental approaches, involving sensory analysis (organoleptic) through blind tests comparing two variables. The shrimp content in the SCRAP is 50.2%, while the comparison variable is Conventional MSG. In addition, proximate analysis was conducted to determine the nutritional composition of each sample.

Favorability Test

Following the production phase of the innovative product SCRAP, a sensory evaluation was conducted using a blind test method to assess panelists preferences toward the developed flavor variants. The test was conducted in the Household, Udayana University, Ngurah General Hospital, etc. It involved 20 panelists with a high level of taste



sensitivity. The evaluation criteria included four key sensory attributes: appearance, aroma, taste, and texture. The panelists evaluate SCRAP and conventional MSG through Google Forms.

Figure 1. Panelist's Favorability Distribution

Based on the evaluation results, the SCRAP was the most preferred, receiving 95% of the total votes, followed by Conventional MSG with 5%. These findings indicate that the shrimp- waste-based flavor innovation has a higher consumer acceptance level than conventional MSG. This highlights the strong potential of SCRAP to be further developed as a more natural, sustainable, and diverse alternative to Conventional MSG.

RESULTS AND DISCUSSION

Organoleptic Test Result

Appearance

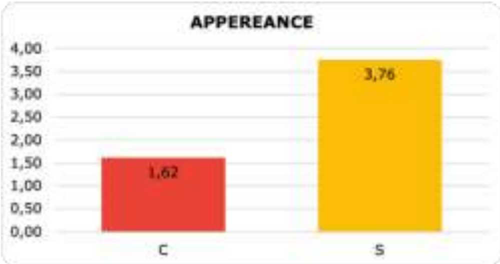


Figure 2. Average value of favorability for appearance.

The table in the image above (Figure 2) shows that, in terms of appearance, the SCRAP's composition (S) obtained an average scale of 3.76 points from 20 panelists. In comparison, the Conventional MSG (C) composition scaled 1.62 points. In terms of appearance, panelists tended to prefer the SCRAP's composition, which displays a creamy orange color derived from shrimp shells, making up 50.2% of its composition. The natural carotenoid pigments, particularly astaxanthin, in heated shrimp shells, stimulate the appetite by their orange hue. This appearance was considered more attractive than Conventional MSG, whose pale color and lack of visual appeal made it less appetizing to the panelists. These values represent the average of the total scale given by 20 panelists, divided by 20.

Aroma

The table in the image below (Figure 3) shows that the SCRAP's composition (S) aroma is more intense than the Conventional MSG (C) composition. From 20 panelists, a scale of 3.95 was obtained for SCRAP, while Conventional MSG received a scale of 1.71. The higher aroma scale of SCRAP is due to its natural ingredients, such as shrimp shells and garlic powder, which release complex volatile compounds. Shrimp shells contribute natural glutamate and carotenoids, while garlic powder adds distinctive sulfur compounds like allicin, creating a fresh and savory aroma easily perceived by the senses.

Figure 3. Average value of favorability for aroma.

On the other hand, Conventional MSG composition has a milder aroma, as its primary role is to enhance taste rather than contribute to its scent. While its aroma scale is lower, relying solely on synthetic MSG can pose potential neurotoxic risks and may affect brain development (especially in early childhood). Choosing a natural seasoning like SCRAP provides a richer sensory experience and offers additional nutritional benefits, supporting healthy growth and helping to prevent stunting.

Texture

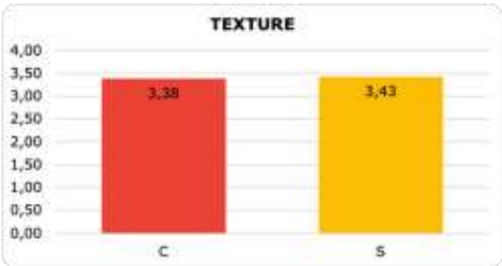


Figure 4. Average value of favorability for texture.

The table in the image above (Figure 4) shows that the SCRAP's composition (S) texture is slightly preferred compared to the Conventional MSG (C). From 20 panelists, SCRAP obtained a scale of 3.43, while Conventional MSG received a scale of 3.38. The slightly higher scale for SCRAP may be due to its natural composition, which gives it a coarser yet appealing granule structure that some panelists found more artisanal and less processed.

In contrast, Conventional MSG's texture is smoother and more uniform due to the use of advanced factory machinery in its production process. This silky texture allows MSG to integrate more easily into food. Replicating such uniformity remains challenging for SCRAP production, as the current process still relies on simpler techniques and tools. Further development, such as using more sophisticated granulation technology, could improve SCRAP's texture, making it easier to manage, more consistent, and less prone to scattering during use.

Taste

The table in the image below (Figure 5) shows that the taste of the SCRAP's composition (S) is preferred over the Conventional MSG (C) composition. From 20 panelists, SCRAP achieved a scale of 3.81, while C received a scale of complex umami flavor that aligns well with the taste preferences of the panelists.

Figure 5. Average value of favorability for taste.

Shrimp shells provide natural umami and subtle seafood tastes that enhance flavor complexity, while garlic powder adds warmth and aroma. In contrast, Conventional MSG offers a substantial umami boost but lacks the layered flavor profile provided by SCRAP's natural ingredients. For children's nutrition plans, SCRAP presents a safer and more nutrient-rich alternative, helping maintain flavor appeal without the potential health concerns of excessive synthetic MSG intake, supporting better nutrition and stunting prevention efforts.

Proximate Analysis Test Results Table 2. Result of proximate

Sample Code	Moisture Content (%bb)	Ash Content (%bb)	Protein Content (%bb)	Fat Content (%bb)	Carbohydrate Content (%bb)	Calories (kcal/100 g)
SCRaP Seasoning	3.6285	43.1560	12.6277	15.6249	24.9629	290.9866

SCRAP Seasonin 1.62. The higher preference for SCRAP is due to the balanced combination of natural glutamate from shrimp shells and the savory depth contributed by garlic powder. This blend creates a richer and from Shrimp Waste

The protein (12,63%) plays a crucial role in supporting the growth and development of body tissues, including muscles and the brain, helping to address one of the significant nutritional deficiencies linked to stunting. It's high mineral, particularly calcium, phosphorus, and zinc derived from shrimp shells, is essential for bone growth, teeth formation, metabolism, and brain development. It is critical in preventing stunting caused by impaired skeletal growth. The presence of healthy fat (15,62%) provides a concentrated energy source, aids in absorbing fat- soluble vitamins (A, D, E, and K). It supports brain development, while its carbohydrate content offers additional energy for daily activities. With a total energy value of 290.99 kcal/100 g, SCRAP can help meet part of a child's daily caloric needs, particularly in stunting-prone areas. When incorporated as a natural seasoning, SCRAP enhances food flavor, stimulates appetite, and delivers essential nutrients that contribute to better growth outcomes and a reduced risk of stunting.

CONCLUSION AND SUGGESTIONS

This research has successfully developed SCRAP, a natural flavor enhancer derived from Litopenaeus vannamei shrimp waste, through a production process involving washing, slicing, roasting, blending, and re-drying to produce a fine seasoning powder without synthetic additives. This processing method effectively preserved the natural glutamate, protein, calcium, and other essential nutrients, enabling SCRAP to function as a viable substitute for monosodium glutamate (MSG) in early nutrition plans.

Proximate analysis revealed that SCRAP contains 12.63% protein, 15.62% fat, 24.96% carbohydrates, 43.16% minerals, and 290.99 kcal/100 g of energy. These nutritional components, such as protein, calcium, and phosphorus, are essential for supporting growth, bone mineralization, and cognitive development, aligning with the nutritional requirements for stunting prevention in early childhood or toddlers. This highlights SCRAP's role in contributing to stunting reduction, directly supporting the achievement of SDG 2 on Zero Hunger and SDG 3 on Good Health and Well-Being.

Table 3. Comparison of the Organoleptic Method

No	SCRAP	Conventional MSG
1	3,81	1,62
2	3,95	1,71
3	3,76	1,62
4	3,43	3,38

Organoleptic evaluation further demonstrated high consumer acceptance, with the SCRAP scoring higher than conventional MSG in taste, aroma, and appearance. It also shows no significant difference in texture. This indicates that SCRAP meets safety and nutritional standards and satisfies sensory preferences, making it an acceptable and healthier alternative to conventional MSG for early childhood or toddlers consumption.

Further research is recommended to optimize SCRAP's production process by adopting more advanced drying and granulation technologies to achieve a finer and more uniform texture comparable to conventional MSG, thus enhancing its ease of use in household and industrial applications. Long-term nutritional intervention research is also necessary to evaluate the sustained impact of SCRAP consumption on growth parameters and cognitive development in early childhood or toddlers, particularly in stunting-prone regions.

In addition, expanding sensory evaluation with larger and more diverse consumer groups will strengthen the validity of acceptance data across different cultural and demographic segments. Commercial-scale production trials should be conducted to assess cost efficiency, supply chain feasibility, and compliance with food safety regulations. Moreover, by utilizing shrimp waste (head, shell, and tail) as raw material, SCRAP supports zero-waste practices and contributes to sustainable food innovation, in line with SDG 12 on Responsible Consumption and Production. By integrating these improvements, SCRAP has the potential to be established as a widely accepted, safe and nutritionally beneficial alternative to MSG that supports both public health and sustainable child nutrition systems. In this regard, SCRAP not only serves as a scientific innovation in food technology but also helps to support and accelerate the achievement of the Sustainable Development Goals (SDGs): SDG 2 on Zero Hunger, SDG 3 on Good Health and Well-Being, and SDG 12 on Responsible Consumption and Production.

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