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UTILIZATION OF SHRIMP SHELL WASTE INTO ORGANIC SEASONING: EMPOWERMENT OF PKK MOTHERS IN SAWOJAJAR 2 THROUGH A ZERO WASTE LIVING APPROACH

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ABSTRACT

Background: Shrimp shell waste is a significant household organic waste problem in urban areas, including Sawojajar 2, Malang. Most housewives discard shrimp shells directly into trash bins, causing unpleasant odors and environmental pollution. However, shrimp shells contain high protein (up to 40%), calcium (40-50%), and chitin (20-36%) that can be processed into organic seasoning as a natural flavor enhancer. Method: This community service activity employed a Participatory Action Research (PAR) approach involving 20 PKK mothers in RT 26, Sawojajar 2. The activities were conducted over four sessions including: (1) socialization and problem identification, (2) demonstration of seasoning production, (3) hands-on practice, and (4) evaluation and follow-up. Data were collected through pre-test and post-test questionnaires, product quality assessment, and a follow-up survey after two weeks. Results: The results showed a significant increase in participants' knowledge, with average pre-test scores of 42.5 increasing to 85.7 in the post-test (103% improvement). The percentage of participants scoring ≥70 increased from 10% (2 participants) to 90% (18 participants). In terms of practical skills, 15 out of 20 participants (75%) successfully produced good-quality seasoning. Production cost analysis revealed that homemade seasoning costs only 5,500-15,500 per 100 grams, compared to 25,000-35,000 for commercial products. The product demonstrated a shelf life of up to 2 months at room temperature and 5 months under refrigeration. Conclusion: Processing shrimp shell waste into

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organic seasoning is an effective zero-waste solution that provides economic savings and environmental impact reduction. This participatory empowerment model can be replicated in other communities.

1. INTRODUCTION

1.1 Background

Shrimp (*Litopenaeus vannamei*) is one of the most widely consumed seafood products in Indonesian households. Based on data from the Ministry of Maritime Affairs and Fisheries (Windayati, Onoyi, and Kurniawati 2024), national shrimp consumption reached 1.2 kg per capita per year, with a continuing increasing trend. However, this high consumption pattern generates significant organic waste in the form of shrimp heads and shells, which constitute approximately 40-50% of the total shrimp weight (Ariestiningsih et al. 2025; Riani et al. 2024).

In urban residential areas such as Sawojajar 2, Malang, shrimp shell waste has become a persistent household problem. A preliminary survey conducted in March 2026 involving 20 PKK mothers in RT 26 revealed that 19 out of 20 participants (95%) routinely cook shrimp, yet only 2 participants (10%) knew that shrimp shells could be processed into useful products. Furthermore, 100% of participants complained about unpleasant odors from kitchen waste, particularly when shrimp shells remained in trash bins for more than 24 hours.

From an environmental perspective, organic waste disposal in landfills contributes to methane gas emissions, a greenhouse gas 25 times more potent than carbon dioxide (Mia, Elfrida, and Mahyuny 2023). The zero-waste living approach offers an alternative solution by encouraging households to minimize waste through reuse and recycling at the source (Maulina, Nurwati, and Hasdar 2024).

1.2 Nutritional and Functional Potential of Shrimp Shells

Despite being considered waste, shrimp shells contain substantial nutritional components. According to various studies (Rosulva et al. 2025; Thamrin et al. 2025; Windayati et al. 2024), shrimp shells consist can describe at Table 1.

Table 1. Shrimp shells consist

Component	Percentage	Technical Function
Protein	Up to 40%	Contributes to natural savory flavor (umami)
Calcium carbonate	40-50%	Provides mineral content
Chitin/Chitosan	20-36%	Natural fiber; contributes to texture and product stability
Astaxanthin	Small amount	Natural pigment (orange-red color)

The protein content contributes to the natural savory taste when the shells are roasted, eliminating the need for additional monosodium glutamate (MSG). The chitin component provides structural integrity to the final product and may contribute to its shelf stability through physical rather than biological mechanisms.

1.3 Problem Identification

Based on the preliminary survey, three main problems were identified among PKK mothers in Sawojajar 2:

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Problem1: Dependence on synthetic seasonings. The majority of participants (85%, 17 out of 20 mothers) routinely used synthetic seasonings containing monosodium glutamate (MSG). Although they recognized potential concerns about excessive MSG consumption, they lacked affordable and accessible natural alternatives. (Maulina et al. 2024; Thamrin et al. 2025)

Problem2: Waste management challenges. Decomposing shrimp shells produce foul odors, attract pests, and accelerate household waste accumulation. With waste collection services operating only twice weekly in Sawojajar 2, residents faced significant sanitation challenges. (Rahmi, Puteri, and Anggriawin 2016; Teguh et al. 2025)

Problem3: Household expenses. Participants reported spending 16,000-24,000 monthly on commercial powdered broths and seasonings. This expenditure, while seemingly small, represents a recurring financial burden for low-income households. According to various literature we reviewed (Rosulva et al. 2025; Windayati et al. 2024).

1.4 Objectives

This community service activity had three specific objectives:

1. To increase the knowledge and skills of PKK mothers in Sawojajar 2 regarding the processing of shrimp shell waste into organic seasoning.
2. To evaluate the effectiveness of participatory training methods in improving participants' practical abilities.
3. To analyze the economic feasibility and sustainability potential of homemade organic seasoning production.

1.5 Expected Benefits

The expected benefits of this activity include: (1) reduced household expenditure on commercial seasonings, (2) decreased organic waste volume and associated odors, (3) reduced dependence on synthetic additives in daily cooking, and (4) potential additional income generation through home-based production.

2. METHOD

2.1 Time and Location

This community service activity was conducted from April 4 to April 25, 2026, over four sessions scheduled on Saturdays and Sundays from 09:00 to 11:00 AM Western Indonesian Time (WIB). The activity took place at a resident's home in RT 26, Sawojajar 2, Malang, a central location accessible to all participants without requiring motorized transportation.

2.2 Participants

The participants were 20 PKK (Family Welfare Empowerment) mothers from RT 26, RW 03, Sawojajar 2. Participant characteristics are presented in Table 1. Before the activity began, each participant was asked to complete a pre-test to measure their initial knowledge about utilizing shrimp shell waste. The results have already been presented in the introduction.

Table 2. Participant Demographic Characteristics

Characteristic	Category	Number (n=20)	Percentage
Age	30-35 years	7	35%
	36-45 years	13	65%

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Education	Elementary school	4	20%
	Junior high school	9	45%
	Senior high school	7	35%
Occupation	Homemaker	14	70%
	Employed outside home	6	30%

2.3 Research Design and Approach

This activity employed a Participatory Action Research (PAR) approach, which emphasizes active involvement of community members in all stages of the intervention (Agustina, Heriyawati, et al. 2023; Hudayana et al. 2019). Unlike top-down training models, PAR positions participants as co-learners and co-producers of knowledge rather than passive recipients.

2.4 Stages of Activity

The activity was organized into four stages following the PAR framework, as shown in Table 2.

Table 3. Stages of PAR Implementation

Stage	Session	Activities	Duration
Stage 1: Preparation & Problem Identification	Session 1 (Saturday)	– Coordination with PKK chairperson – Preliminary survey and pre-test administration – Socialization of shrimp shell waste potential – Assignment to collect and store shrimp shells	2 hours
Stage 2: Demonstration	Session 2 (Sunday)	– Step-by-step demonstration of organic seasoning production – Explanation of quality indicators (color, aroma, texture) – Distribution of samples for home tasting	2 hours
Stage 3: Hands-on Practice	Session 3 (Saturday)	– Participants practice independently under supervision – Troubleshooting assistance (e.g., burnt product, blending issues) – Product quality assessment	2 hours
Stage 4: Evaluation & Follow-up	Session 4 (Sunday)	– Post-test administration – Taste test and sensory evaluation – Discussion of obstacles and solutions – Sustainability planning	2 hours

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2.5 Organic Seasoning Production Procedure

a. The production procedure for shrimp shell organic seasoning followed the method adapted from Diana et al. (2023) and (Rahmi et al. 2016), with modifications for household-scale production:
b. Step 1: Preparation
   - Collect shrimp shells from household cooking
   - Wash thoroughly under running water
   - Soak in water mixed with lime juice (1 tablespoon per liter) for 10 minutes to reduce fishy odor
c. Step 2: Drying
   - Drain and sun-dry for 1-2 hours, or pat dry with a clean cloth
d. Step 3: Roasting
   - Roast in a non-stick pan over the lowest flame for 20-25 minutes
   - Stir continuously to prevent burning
   - Observe color change from pale pink to bright orange (indicator of doneness)
e. Step 4: Cooling and Grinding
   - Allow to cool in the pan for 15 minutes
   - Blend or grind until fine powder consistency
   - Sieve using a flour sifter to ensure uniform texture
f. Step 5: Seasoning and Packaging
   - Add salt and palm sugar (ratio 10:1:0.5 for powder:salt:sugar)
   - Store in clean, dry glass jars (previously used jam or sauce jars)





Figure 1. Demonstration of Making Organic Shrimp Shell Seasoning



Figure 2. Mothers Practicing the Activity

2.6 Data Collection Instruments

Data were collected using the following instruments:
Pre-test and Post-test Questionnaire: A 10 item multiple-choice questionnaire covering: (1) knowledge of shrimp shell nutritional content, (2) understanding of processing

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methods, (3) awareness of economic benefits, and (4) zero-waste concepts. The questionnaire was developed based on literature review and validated through expert judgment by two community service faculty members. Reliability was tested using the split-half method, yielding a Cronbach's alpha coefficient of 0.82, indicating acceptable internal consistency. The complete instrument is provided in pretest/posttest question here.

Pretest/Posttest Questions

1. The main components of shrimp shells are...
   a. Saturated fat and sugar
   b. Protein, calcium, and chitin
   c. Vitamin C and crude fiber
   d. Carbohydrates and iron

2. What are the main benefits of chitin/chitosan contained in shrimp shells?
   a. Adding sweetness to dishes
   b. Chemically preserving food
   c. Binding fat and potentially lowering cholesterol
   d. Giving food a red color

3. What percentage of protein is contained in shrimp shells, according to the literature?
   a. Less than 10%
   b. Around 20%
   c. Up to 40%
   d. More than 60%

4. The simplest method for processing shrimp shells into flavoring for the household scale is...
   a. Soaking in acetic acid for 24 hours
   b. Boiling at high heat for 3 hours
   c. Roasting over low heat
   d. Steaming for 1 hour

5. Signs that shrimp shells are perfectly cooked when roasted are...
   a. Brownish-black in color
   b. Bright orange in color
   c. Thick smoke emitted
   d. Soft in texture

6. What is the estimated production cost of 100 grams of shrimp shell flavoring (using used jars)?
   a. 25,000 - 35,000
   b. 15,000 - 20,000
   c. 5,000 - 10,000
   d. 1,000 - 3,000

7. How long can shrimp shell flavoring be stored at room temperature in a closed container based on initial observations?
   a. 1 week
   b. 2 months
   c. 6 months
   d. 1 year

8. Which of the following is NOT a benefit of processing shrimp shell waste into flavoring?
   a. Savings on monthly shopping expenses
   b. Reducing the volume of household organic waste
   c. Increasing the risk of disease caused by MSG
   d. Potentially providing an additional source of income

9. What should you do if shrimp shells produce a fishy aroma when roasting?
   a. Turn off the heat and discard the ingredients
   b. Add food flavoring
   c. Continue roasting because the aroma will disappear after 10-15 minutes
   d. Increase the heat to cook faster

10. The zero-waste principle applied in this activity is...
    a. Burning all waste to prevent it from piling up
    b. Converting waste into valuable products at the source
    c. Sending all waste to a landfill
    d. Buying as many packaged products as possible

Product Quality Assessment Rubric: A 4-point rubric assessing: (1) color (1=dark brown/burnt, 4=bright orange), (2) aroma (1=burnt/fishy, 4=savory pleasant), (3) texture (1=coarse/moist, 4=fine dry powder).

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Follow-up Survey: Conducted via WhatsApp group two weeks after the activity, measuring: (1) whether participants continued production, (2) frequency of production, and (3) whether they shared/sold to others.

2.7 Data Analysis

Quantitative data from pre-test and post-test were analyzed using descriptive statistics (mean, percentage, range). The significance of knowledge improvement was assessed using a paired t-test, with a significance level of $\alpha=0.05$. Qualitative data from participant feedback were analyzed thematically.

2.8 Success Indicators

Three success indicators were established prior to implementation.

Table 4. Success Indicator

Indicator	Measurement Method	Target
Knowledge improvement	Pre-test vs. post-test comparison	≥70% of participants score ≥70 on post-test
Practical skill mastery	Product quality assessment	≥80% of participants produce usable product
Sustainability	WhatsApp follow-up survey (2 weeks)	≥50% continue independent production

3. CONCLUSSION

3.1 Knowledge Improvement

The pre-test and post-test results from all 20 participants are presented in Table 3.

Table 5. Comparison of Pre-test and Post-test Scores

Parameter	Pre-test	Post-test	Change
Mean score	42.5	85.7	+43.2 (+103%)
Median score	40.0	87.5	+47.5
Range	20-70	65-100	-
Participants with score ≥70	2 (10%)	18 (90%)	80%
Participants with score <70	18 (90%)	2 (10%)	-80%

A paired t-test revealed that the knowledge improvement was statistically significant ($t(19) = 14.32$, $p<0.001$). This finding demonstrates that the participatory training method effectively increased participants' understanding of shrimp shell waste utilization. This result aligns with previous community service studies using similar PAR approaches (Agustina, Akhriza, et al. 2023; Agustina, Heriyawati, et al. 2023; Agustina, Andayani, and Hariani 2022; Putri et al. 2022; Sulaeman, Bramasta, and Makhrus 2023).

3.2 Practical Skills Assessment

Following the hands-on practice session (Session 3), participant products were assessed using the quality rubric. Results are presented in Table 6.

Table 6. Product Quality Assessment Results

Quality Category	Criteria	Number of Participants (n=20)	%
Good	Bright orange color, savory aroma, fine powder	15	75 %
Acceptable	Slightly brownish color, mild aroma,	3	15 %

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	slightly coarse		
Poor	Dark brown/burnt, bitter aroma	2	10 %

The 75% success rate (good quality) combined with acceptable quality products (15%) gives a total success rate of 90%. The two participants who produced poor-quality products received additional guidance and successfully produced acceptable products on their second attempt.

Common difficulties encountered included:

- **Flame control:** Participants initially used medium-high flames, causing exterior burning before interior drying. The solution was emphasizing "lowest flame only."
- **Insufficient stirring:** Chatting during roasting led to sticking. Solution: reminder that stirring must be continuous.
- **Grinding challenges:** Slightly moist shells did not blend finely. Solution: adding a small amount of salt as a drying agent.

3.3 Taste Test and Acceptability

During Session 4, a blind taste test was conducted using four dishes prepared by participants using their own homemade seasoning. Results are presented in Table 7.

Table 7. Sensory Evaluation Results (1-5)

Parameter	Dish 1	Dish 2	Dish 3	Dish 4	Mean
Color	4.5	4.2	4.3	4.0	4.25
Aroma	4.7	4.5	4.6	4.2	4.50
Savory taste	4.6	4.4	4.5	4.1	4.40
No bitter aftertaste	4.8	4.3	4.5	3.8	4.35
Mean	**4.65**	**4.35**	**4.48**	**4.03**	**4.38**

Dish 4 received the lowest scores because the product was slightly burnt (flame had been temporarily too high during roasting). Overall, however, all four dishes scored above 4.0 (on a 5-point scale), indicating high acceptability. All 20 participants stated that shrimp shell seasoning was suitable for daily cooking. The substantial improvement (103% increase) suggests that practical demonstration combined with hands-on practice is more effective than lecture-only methods. As noted, adult learning is most effective when participants can directly connect new information to their daily experiences (Astari and Efelina 2021).

3.4 Shelf-Life Observation

Product shelf life was evaluated through observation of samples stored under two conditions (without preservatives), see Table 8.

Table 8. Shelf-Life Observer Condition

Storage Condition	Observed Shelf Life	Limiting Factor
Room temperature (25-30°C) in sealed jar	Up to 2 months	Gradual moisture absorption
Refrigerator (chiller, 4-8°C)	Up to 5 months	No spoilage detected at 5 months

The extended shelf life is attributed to: (1) very low moisture content after roasting, (2) proper storage in airtight containers, and (3) the roasting process which reduces microbial load. These findings are based on visual, aroma, and texture monitoring, not laboratory microbial analysis. Therefore, they should be considered preliminary observations.

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3.5 Economic Analysis

Production cost analysis was conducted collaboratively with participants, as shown in Table 9 and comparison with commercial product in Table 10.

Table 9. Production Cost per 100 grams of Seasoning

Component	Details	Cost
Shrimp shells	Waste from own cooking	0
Garlic (optional)	4 cloves	1
Salt	2 teaspoons	500
Palm sugar	1 teaspoon (optional)	500
LPG gas	30 minutes roasting	3
Electricity (blender)	10 minutes	500
Glass jar	Used jar (reused)	0
Total (using used jar)		**5,5**
New jar	100 ml capacity	10
Total (using new jar)		**15,5**

Table 10. Comparison with commercial products:

Product	Price per 100 grams
Shrimp shell seasoning (homemade, used jar)	5,500
Shrimp shell seasoning (homemade, new jar)	15,500
Commercial powdered broth (local shop)	25,000-35,000

Potential profit calculation (if commercialized):

Assumptions:

- Production volume: 1 kg powder (10 packages @ 100 grams)
- Selling price: 35,000/package (still below commercial products)
- Production cost (new jar): 15,500/package

Calculation:

- Revenue: 10 × 35,000 = 350,000
- Cost: 10 × 15,500 = 155,000
- **Profit: 195,000 per 1 kg production**

This analysis indicates that even with new jars, the profit margin is approximately 55.7%, making this a potentially viable home-based business. However, this calculation does not include labor costs or equipment depreciation, which should be considered for full business feasibility.

3.6 Sustainability (Follow-up Results)

A follow-up survey conducted via WhatsApp two weeks after the activity (n=20 participants) revealed in Table 11.

Table 11. Sustainable Follow-up Indicator

Indicator	No	%
Still regularly producing at home	12	60%
Have shared with neighbors/relatives	5	25%
Have started selling (informal)	2	10%
Reported family preference for homemade seasoning	2	10%

The 60% sustainability rate exceeds the 50% target. This suggests that the participatory approach, combined with tangible economic benefits, motivated participants to continue production independently. The PKK chairperson has since incorporated this activity into a monthly "PKK Healthy Kitchen" program.

Based on the implementation and evaluation of this community service activity, the following conclusions are drawn:

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1. **Shrimp shell waste has significant potential** for processing into organic seasoning. The protein content (up to 40%) contributes natural savory flavor, while chitin (20-36%) and low moisture content support product stability.
2. **The participatory training method was effective.** Mean knowledge scores increased from 42.5 (pre-test) to 85.7 (post-test), a 103% improvement. The percentage of participants scoring ≥70 increased from 10% to 90%.
3. **Practical skill mastery reached 75%** for good-quality products and 90% for acceptable-quality products. The primary challenges (flame control, stirring, grinding) were addressed through targeted troubleshooting.
4. **From an economic perspective**, homemade seasoning costs only 5,500-15,500 per 100 grams compared to 25,000-35,000 for commercial products, representing potential savings of 70-85%. The product shelf life of 2 months (room temperature) to 5 months (refrigerated) provides adequate storage duration for household use.
5. **Sustainability was achieved at 60%**, with participants continuing independent production two weeks post-intervention. This exceeds the 50% target and demonstrates the viability of the zero-waste approach at the household level.
6. **Environmental impact** includes reduced organic waste volume and associated odors, contributing to cleaner household sanitation in Sawojajar 2.

Recommendations

1. For PKK Mothers (Participants):
   a. Continue regular practice to maintain and improve skills
   b. Share knowledge with neighbors to amplify environmental impact
   c. Store collected shells in freezer to prevent spoilage between production sessions
   d. Experiment with additional flavors (lime leaves, lemongrass, black pepper)

2. For Future Community Service Teams:
   a. Provide more equipment sets (ideally 1 set per 3-4 participants) to maximize practice time
   b. Involve health cadres to disseminate information about natural seasoning alternatives
   c. Organize post-training competitions to maintain motivation
   d. Establish partnerships with waste banks or government agencies for marketing support

For Local Government:

1. Provide budget support for shared equipment (blenders, scales) at the RT level
2. Offer incentives for households consistently processing organic waste
3. Integrate this activity into existing zero-waste village programs

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