Food Research 8 (Suppl. 8) : 61 - 64 (2025)
Journal homepage: https://www.myfoodresearch.com

FOOD RESEARCH

RESEARCH PAPER

Exploring the preservation and modenisation of chilled pre-packed umai: Sarawak traditional raw fish delicacy

*Chua, H.P. and Nicholas, D.

Food Science and Technology Research Centre, Malaysian Agriculture Research and Development Institute (MARDI), MARDI Kuching, Malaysia

Article history:
Received: 24 April 2024
Received in revised form: 15 December 2024
Accepted: 15 December 2024
Available Online: 22 February 2025

Keywords:
Pre-packed umai,
Sliced fish,
Marinating sauce,
Convenient delicacy,
Chill-storage life

DOI:
https://doi.org/10.26656/fr.2017.8(S8).7

Abstract

Umai is a popular traditional raw fish delicacy in Sarawak, consisting of thinly sliced raw fish cured in sour fruit juice mixed with other spices. Chilled pre-packed umai holds the potential to become a convenient delicacy, as it allows for direct mixing of sliced fish with the marinating sauce upon serving. This study aimed to modernize the presentation of pre-packaged chilled red tilapia umai, which includes fish cutlets and marinade sauce, for market convenience. A study was conducted to extend the chill-storage life of sliced fish (Red Tilapia cutlets) through a dipping treatment in an organic acid solution. The results indicated that sliced fish frozen at -23°C for 7 days and treated with a 1.5% citric acid dipping solution exhibited the best storage quality, as evidenced by lower total aerobe and total coliform counts, as well as enhanced colour intensity. Fish muscle tissue often undergoes acid-induced denaturation within the pH range of 2 to 5. Therefore, the umai sauce was formulated to have a fixed pH value of 3.3, which met the denaturation process and sensory attributes, as well as the FDA requirements for limiting the growth of bacterial pathogens that are of greatest concern in seafood processing. Compared to commercial chilli sauce, umai sauce has significantly lower calorie and carbohydrate content, with 49.7 kcal and 8.7%, respectively, compared to 113 kcal and 24.5%.

1. Introduction

Umai, also known as Sarawak raw fish salad (Figure 1), is a popular traditional dish originating from the Melanau community in Sarawak's Mukah region. It consists of thinly sliced raw fish cured in sour fruit juice, mixed with onions, chillies, and shallots, and seasoned with salt and spices. Comparable to Japan's sashimi and Latin America's ceviche, umai distinguishes itself through its unique preparation and serving. However, its short shelf-life limits broader distribution and commercial viability. To address this issue, a method for extending umai's storage life in chilled pre-packed form (Figure 2) is crucial for maintaining quality, safety, and minimizing wastage (Chua, 2021).

Figure 1. Umai, Sarawak raw fish salad.

Figure 2. Chilled pre-packed umai.

The growing demand for chilled and frozen foods presents an opportunity for umai to emerge as a convenient delicacy, meeting consumers' desire for quick and easy preparation (Chua *et al*., 2021). Yet, concerns about the safety of raw seafood arise alongside this trend. Uncooked seafood, including umai, can pose health risks due to parasites like nematodes (*Anisakis* sp.) and trematodes (*Heterophyes* sp.) (Golden *et al*., 2022). Therefore, ensuring freshness and proper pre-treatments for fish is essential. The safety guidelines from the Food and Drug Administration (FDA, 2022) recommend blast-freezing to at least –35°C for 15 hours; or regular freezing to at least –23°C for 7 days. However, this

*Corresponding author.
Email: *hpchua@mardi.gov.my*

eISSN: 2550-2166 / © 2025 The Authors.
Published by Rynnye Lyan Resources

practice has not been adopted in traditional umai preparation due to the belief that it may cause undesirable changes in the eating quality of the product.

This study aimed to create a modern presentation for chilled pre-packed umai using red tilapia, featuring umai cutlets (sliced fish) and marinating sauce, catering to market convenience. The work involved extending umai cutlets' chill-storage life through an organic acid solution dipping treatment and developing the umai marinating sauce. Comprehensive assessments covered physical, chemical, microbiological, and sensory aspects.

2. Materials and methods

2.1 Dipping treatment of umai cutlets

Live red tilapia (*Oreochromis niloticus*) was deboned and cut into fillets, which were then soaked in a 2% sodium tripolyphosphate (STPP) solution for 2 minutes to reduce rancidity and dripping. These fillets were then packed into low-density polyethylene (LDPE) bags and frozen at -23°C for 7 days, following FDA guidelines (2023).

Three organic acid dipping solutions (citric acid 1.5%, lactic acid 2.0%, acetic acid 3.0%) were prepared by dissolving them in deionized distilled water. The solution pH of 4.00±0.20 was determined by the organic acid's strength. The pH value of 4 was chosen to preserve taste, texture, and colour based on preliminary tests, avoiding taste alterations at lower pH levels, and lacking shelf-life extension at higher pH levels.

Umai cutlets, measuring approximately 5 cm × 1 cm × 3 mm, were sliced from thawed fillets. A total of 100 g duplicate samples were immersed in a 300 mL dipping solution, agitated for 2 mins, drained for 5 minutes, and then packed in polypropylene (PP) containers. After a 10 -minute chill at -18±1°C, cutlets were stored at 2±2°C, with untreated cutlets as the control.

The study spanned a predetermined 8-day storage period, during which cutlet samples were intermittently assessed. Evaluations covered physical attributes (pH, color intensity), chemical analysis (total volatile base nitrogen), microbiological testing (total aerobic bacteria, coliform count), and sensory evaluation to determine the dipping treatment's impact on cutlet quality.

2.2 Development of umai marinating sauce

Umai marinating sauce was processed using a sensory-developed formulation from preliminary studies. Fresh ingredients (Table 1) were processed following the outlined steps in Figure 3. As a shelf-stable sauce, preservatives such as sodium benzoate may be added at a dosage of not exceeding 750 mg/kg. Nonetheless, the use of preservatives is not required for short-term storage in chilled conditions, owing to the low pH condition of the sauce.

Table 1. Umai marinating sauce formulation.

Ingredients	(%)(w/w)
Onion	24.0
Chilli	14.0
Shallot	14.0
Ginger	8.0
Lime peel	1.2
Lime juice	17.6
Acetic acid 4%	17.6
Salt	2.7
Monosodium glutamate	0.9

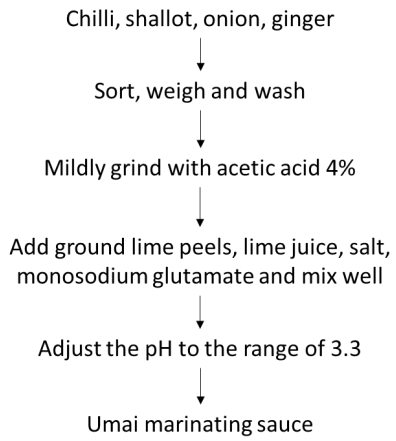

Figure 3. Processing of umai marinating sauce.

The sauce's moisture, protein, fat, crude fibre, and ash content were analyzed in duplicate using the Association of the Official Analytical Collaboration (AOAC) International standard method (2023). Additional evaluations encompassed pH, water activity, percentage of titratable acid, soluble solids, viscosity, and color expressed in the L*, a*, b* notation.

2.3 Sensory evaluation

All sensory evaluations were carried out after the results of the microbiological evaluations obtained showed that the products were safe for consumption. Chilled cutlet samples were assessed, and then transformed into umai by mixing with the umai marinating sauce. A 30-person taste panel compared these umai samples with freshly prepared samples (control) using a 9-point hedonic scale, rating from 1 (dislike extremely) to 9 (like extremely) (Poste *et al*., 1991).

3. Results and discussion

3.1 Preparation of umai cutlets

In this experiment, organic acids were added as bacteriostatic agents to deter spoilage and pathogens.

https://doi.org/10.26656/fr.2017.8(S8).7 © 2025 The Authors. Published by Rynnye Lyan Resources

The results of the physical, chemical, microbiological analysis and sensory evaluation of organic acid-treated umai cutlets on the 8th day of storage at 2±2°C are shown in Table 2.

Fish muscle tissue contains around 70-84% water and 15-24% protein, primarily myosin. Proteins are intricate molecules composed of amino acid chains that fold into three-dimensional structures. Heating causes denaturation, a process where proteins lose their natural structure due to broken hydrogen bonds (Strzelczak *et al*. 2021). Acid also denatures proteins similarly. In umai preparation, acidic marinating sauce denatures fish muscle proteins, resulting in a thick, dense, opaque appearance and firm texture, akin to cooking. However, this change is purely structural, not involving the chemical processes of heat-induced cooking (Logren *et al*., 2022).

Umai cutlets' pH consistently rose over the 8-day storage period, potentially due to spoilage bacteria generating alkaline compounds such as amines and ammonia (Metin *et al*., 2001). The limit of acceptability is usually 6.8-7.0, which is lower in acid-treated samples. Control samples began at a pH of 6.13, reaching 7.05 by day 8, while acid-treated samples saw smaller increases from an initial pH of 4.74 to a maximum of 5.18. However, differences in pH between these treated samples were found to be statistically insignificant ($p > 0.05$). For most organic acids to act as effective anti-microbial agents, a condition of low pH values around 5.5 is required (Papadochristopoulos *et al*., 2021).

The total volatile base nitrogen (TVBN), a result of microbial spoilage and endogenous enzymes, is controlled in fish products with an acceptability limit of 35 mg TVBN/100 g (Metin *et al*., 2001). During storage, all treated samples remained below 28 mg/100 g. By the 8th day, samples treated with an organic acid solution had significantly lower TVBN values ($p < 0.05$) than the controls. Acid-treated samples exhibited reduced microbial loads and slower spoilage, resulting in consistently lower TVBN levels. Control samples on the 8th day recorded a TVBN value of 39.8 mg/100 g; surpassing or nearing the 35 mg/100 g limit, which is considered less acceptable according to sensory evaluation.

Microbiological analysis revealed increasing total aerobes and coliform counts over time in all umai samples. Initially, control samples had 3.8 log CFU/g total aerobes and 1.3 log CFU/g coliforms, rising to 6.3 and 3.3 log CFU/g, respectively, by day 8. Statistical analysis showed significant differences ($p < 0.05$) in total aerobes and coliform counts between control and organic acid-treated samples. Acid-treated samples had aerobes counts below 6.0 log CFU/g, indicating organic acid treatment inhibited mesophilic aerobic bacteria growth. Citric acid 1.5% dipping solution exhibited the lowest total aerobes count on day 8. All organic acid-treated samples displayed significantly lower total coliform counts, with acetic acid 3% or citric acid 1.5% dipping solutions showing the lowest counts by day 8.

Umai cutlets were deemed acceptable if their odour, appearance, and texture remained unchanged, with a score above 6. Sensory evaluation indicated significant differences ($p < 0.05$) between control and treated samples after 8 days. Panellists preferred treated samples over control, with treated samples consistently earning higher scores until the 6th day of storage. An acidified dipping solution at pH 4 had no adverse effects on taste and texture.

While umai cutlets have various quality attributes, colour stands out as a crucial consumer criterion. Colour measurements revealed a significant difference ($p < 0.05$) between control and treated samples after 8 days. In control samples, umai cutlet lightness (L*) increased from 46.94 to 62.58 initially, and redness (a*) decreased

Table 2. Physicochemical properties of umai cutlets on the 8th day of storage at 2±2°C.

Parameters	Dipping Treatments (pH 4.00±0.20)			
	Control	Citric acid 1.5%	Lactic acid 2%	Acetic acid 3%
pH	7.05^{a}	5.11^{b}	5.14^{b}	5.18^{b}
TVBN (mg N/100 g)	39.8^{a}	24.6^{b}	27.1^{b}	24.5^{b}
Total viable bacteria (log CFU/g)	6.3^{a}	3.5^{b}	4.1^{bc}	4.7^{c}
Total coliform (log CFU/g)	3.3^{a}	2.4^{c}	2.9^{b}	2.2^{c}
Sensory scores	5.2^{a}	7.3^{bc}	6.9^{c}	7.4^{bc}
Colour				
L	62.58^{a}	50.26^{bc}	51.36^{c}	57.43^{d}
a	1.69^{a}	1.86^{a}	1.66^{a}	1.74^{a}
b	4.29^{a}	4.33^{a}	4.21^{c}	4.05^{b}

Values are presented as mean. Values with different superscripts within the same row are statistically significantly different ($p<0.05$).

https://doi.org/10.26656/fr.2017.8(S8).7 © 2025 The Authors. Published by Rynnye Lyan Resources

from +2.04 to +1.69 over the 8-day storage. A 1.5% citric acid dipping solution exhibited superior colour preservation.

3.2 Development of umai marinating sauce

The physical and chemical characteristics of the ready-to-use umai marinating sauce are displayed in Table 3. Fish muscle tissue denaturation through acid induction frequently occurs within the pH range of 2 to 5. The umai marinating sauce, formulated with a consistent pH value of 3.3, met the denaturation process and sensory attribute, as well as the requirements for limiting the growth of bacterial pathogens that are of greatest concern in seafood processing (FDA, 2022).

Table 3. Physical and chemical characteristics of umai marinating sauce.

Parameter	Value
pH	3.37
Water activity (a_w)	0.98
Titratable acidity (%, as acetic acid)	1.83
Total soluble solids (ºBx, 30ºC)	11.5
Viscosity (cps)	1.84×10^4
Colour	
L	41.54
a	15.27
b	16.45

The comparison of proximate composition between umai marinating sauce and commercial chilli sauce showed that umai marinating sauce exhibits notably lower calorie and carbohydrate levels than its commercial chilli counterpart, specifically, 49.7 kcal compared to 113 kcal and 8.7% versus 24.5%, respectively.

4. Conclusion

This study successfully explored the preservation and modernization of chilled pre-packed umai using red tilapia. It addressed the challenge of extending the storage life of umai cutlets through an organic acid dipping treatment, resulting in improved quality attributes such as pH stability, reduced total volatile base nitrogen, controlled microbial growth, and enhanced sensory appeal. The development of a pH-adjusted umai marinating sauce further complemented the preservation efforts, meeting denaturation requirements and safety standards. These advancements pave the way for the commercial viability of pre-packed umai, offering consumers a convenient and safe culinary experience. While the processing technique of pre-packed umai is relatively simple, strict control is needed along the processing line to maintain the product's quality.

Conflict of interest

The authors declare no conflict of interest.

References

Chua, H.P., Nicholas, D., Teresa, A.M. and Zakaria, A.R. (2021). Ready-to-use Umai Marinating Sauce: Sarawak Umai Instantly at Your Fingertips. In Proceedings MSTE. Malaysia: Penerbitan MARDI.

Chua, H.P. (2021). Umai. In Faridah, H., Syahida, M., Chua, H.P. and Saiful, B.S. (Eds.) Makanan Warisan Malaysia. Malaysia: Penerbitan MARDI. [In Bahasa Malaysia].

Food and Drug Administration (FDA). (2022). Fish and Fishery Products Hazards and Controls. June 2022 Edition. Retrieved from FDA website: https://www.fda.gov/media/80637/download

Golden, O., Caldeira, A.J.R., Rangel, L.F. and Santos, M.J. (2022). Seafood safety and food-borne zoonoses from fish. *EFSA Journal,* 20(Suppl 1), e200409. https://doi.org/10.2903/j.efsa.2022.e200409

Logren, N., Hiidenhovi, J., Kakko, T., Valimaa, A.L., Mäkinen, S., Rintala, N., Mattila, P., Yang, B. and Hopia, A. (2022). Effects of weak acids on the microbiological, nutritional and sensory quality of Baltic Herring (*Clupea harengus membras*). *Foods.* 11(12), 1717. https://doi.org/10.3390/foods11121717.

Metin, S., Erkan, N., Varlik, C. and Aran, N. (2001). Extension of shelf-life of chub mackerel (*Scomber japonicus* Houttuyn 1780) treated with lactic acid. *European Food Research and Technology,* 213(3), 174-177. https://doi.org/10.1007/s002170100362.

Papadochristopoulos, A., Kerry, J.P., Fegan, N., Burgess, C.M. and Duffy, G. (2021). Natural anti-microbials for enhanced microbial safety and shelf-life of processed packaged meat. *Foods,* 10(7), 1598. https://doi.org/10.3390/foods10071598.

Poste, L.M., Mackie, D.A., Butler, G. and Larmond, E. (Eds.) (1991). Laboratory Methods for Sensory Evaluation of Food. Canada: Department of Agriculture.

Strzelczak, A., Balejko, J., Szymczak, M. and Witczak, A. (2021). Effect of protein denaturation temperature on rheological properties of baltic herring (*Clupea harengus membras*) muscle tissue. *Foods,* 10(4), 829-840. https://doi.org/10.3390/foods10040829

 © 2025 The Authors. Published by Rynnye Lyan Resources