EFFECT OF COOKING ON THE PERSISTENT ORGANIC POLLUTANTS IN INDIA'S MOST TRADED SEAFOOD (PENAEUS VANNAMEI) AND ITS HUMAN HEALTH RISK ASSESSMENT

U. ARISEKAR*, R. JEYA SHAKILA, R. SHALINI, G. JEYASEKARAN, AND B. SIVARAMAN

Department of Fish Quality Assurance and Management, Fisheries College and Research Institute
Tamil Nadu Fisheries University, Thoothukudi 628 008, Tamil Nadu, India
*harimfsc2525@gmail.com

ABSTRACT

✓ Pesticide residues (PRs) and toxic metals (TMs) pose substantial food safety concerns globally. This study examines the effects of cooking on TMs and PRs in farmed shrimp (*P. vannamei*) and the potential health hazards. PRs in shrimp ranged from 0.005 (Hg) to 0.396 (As) mg/kg for raw, not detected (Hg) to 0.136 mg/kg for boiled, ND (Hg) to 0.231 (Pb) mg/kg for fried, ND (Hg) to 0.121 (Pb) mg/kg for grilled and ND (Hg) to 0.402 (As) mg/kg for microwaved (MWC) shrimp. All the processing methods significantly affect As (75 and 95%), whereas grilling and microwave cooking showed a noticeable impact on Hg (53 and 58%). Boiling (49%) and grilling (50%) showed a significant effect on Pb level, while frying (7%) and MWC (3%) had a negligible effect. TMs were below the MRL of 0.5 mg/kg set by the European Union. PRs in shrimp ranged from 0.007 to 0.703 µg/kg for raw, not detected (ND) to 0.917 µg/kg for boiled, ND to 0.506 µg/kg for fried, ND to 0.573 µg/kg for grilled, and ND to 0.514 µg/kg for microwave cooked shrimps. PRs in raw and cooked shrimps were below MRL set by CAC and the EC. The processing factor (PF<0.7), paired t-test ($t<0.05$), Tukey test ($p<0.05$), Bray-Curtis similarity index, and matrix plot exhibited that all the four thermal processing methods have a considerable impact on pesticides in the processed shrimps. However, frying (59.4%) and microwave cooking (60.3%) significantly reduced PRs than the boiling (48.8%) and grilling (51.3%). THQ and TTHQ for TMs and HQ and HR for PRs were <1, indicating no health risks for shrimp consumers in India and USA. Culinary processes such as boiling and grilling are recommended to reduce TMs while frying and microwave processing are better methods for minimizing PRs in seafood.

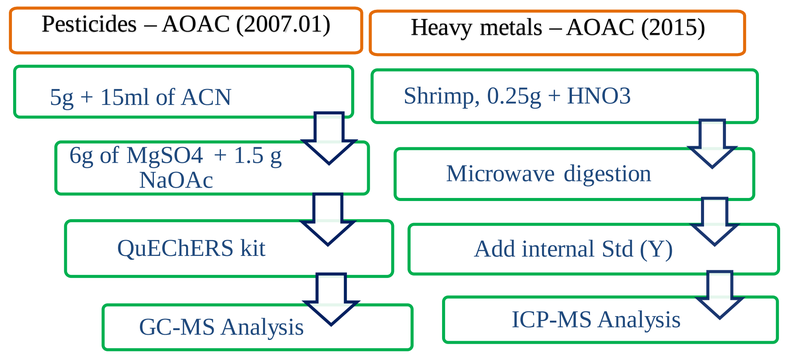
INTRODUCTION

- ✓ Food safety is crucial in today's competitive trading market, as it directly affects human health and seafood export (Meftaul et al., 2020).
- ✓ Farmed shrimp is a delicacy fetching high demand globally. Indian shrimp exports stands at 6,52 253 tons worth 450 million USD. Shrimps are mainly exported to the USA (43.3%), China (24.5%), European Union (11.3%), Japan (6.1%), Vietnam (4.9%), and UAE (3.8%) from India (MPEDA, 2020)
- ✓ Studies are very limited in assessing health risks caused by TMs and PRs in shrimp subjected to different cooking methods.
- ✓ Analysis of TMs and PRs in cooked shrimps/food makes a sensible risk assessment in comparison with the guideline values set by various national and international agencies.

OBJECTIVE

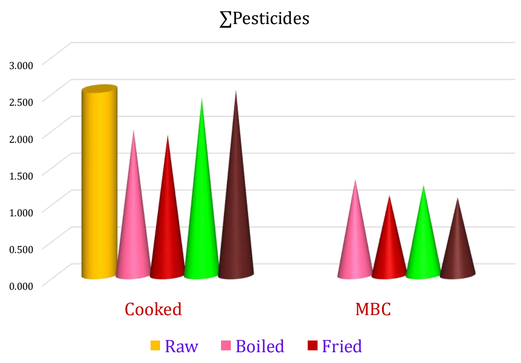
- ✓ To study the influence of different heat treatments on PRs and TMs in farmed pacific shrimp (*P. vannamei*).
- ✓ To assess human health risks through consumption of raw and cooked shrimps.

MATERIALS AND METHODS

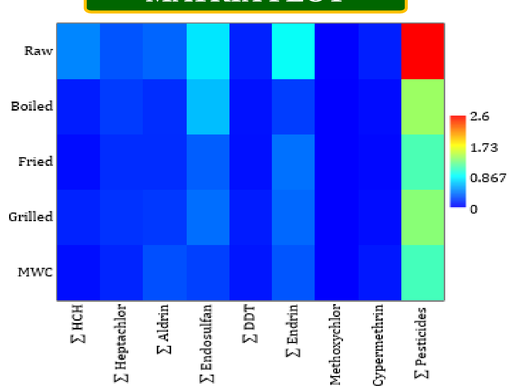


RESULTS

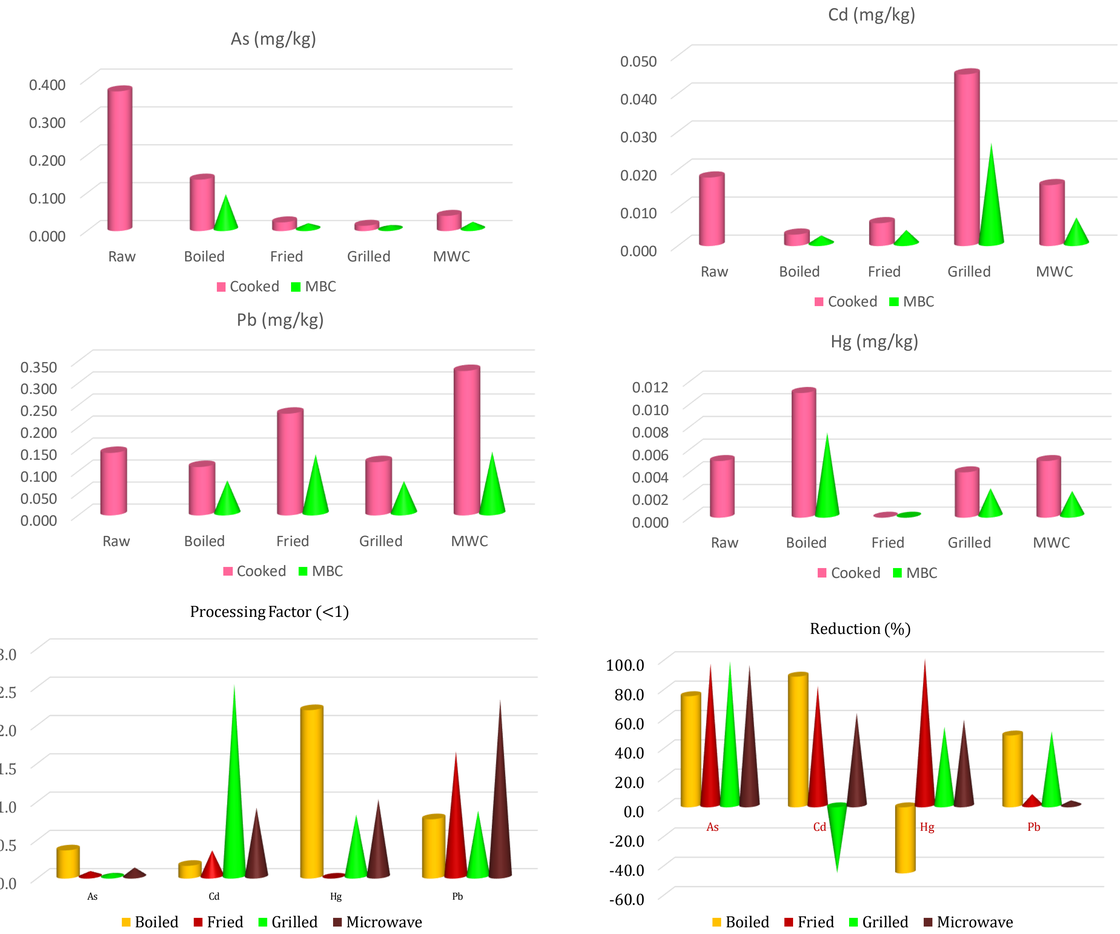
EFFECT OF COOKING ON PESTICIDE RESIDUES



MATRIX PLOT



EFFECT OF COOKING ON TOXIC METALS



RESEARCH FINDINGS

- ✓ Reduction of ∑PRs found in the following order: boiling (48.8%)<grilling (51.3%)<frying (59.4%) <MWC (60.3%).
- ✓ Processing factor (PF<0.7), paired t-test ($t<0.05$), Tukey post hoc ($p<0.05$) test, Bracy-Curtis Similarity Index and matrix plot confirmed that all the four thermal processing methods have a considerable impact on PRs in the processed shrimps.
- ✓ PRs in raw and cooked shrimps were below MRLs set by the CAC (2021) and the EC (86/363/1986 and 57/2007).
- ✓ Hazard quotient (HQ) & hazard ratio (HR) were <1, indicating no non-carcinogenic and carcinogenic health effects through shrimp intake.
- ✓ Estimated maximum allowable shrimp consumption rate (CR_{lim}) suggests an adult can eat >100 shrimp meals/month

CONCLUSIONS

- ✓ Cd, Pb, & Hg in raw and cooked shrimps were below the MRL of 0.5 mg/kg prescribed by EC (EC. No.1881/2006). THQ and TTHQ were <1 indicating no health effects. LCR <1E-06 suggested no cancerous risk possible to occur through shrimp consumption for Indians, Americans, and Chinese.
- ✓ The BCSI, Tuckey test, network plot, processing factor confirmed **boiling and grilling** showed a significant effect on TMs than other cooking processes. These methods reduced noncarcinogenic (THQ/TTHQ) and carcinogenic risk by 61-68% and 11-30% compared to raw and MWC

LIMITATIONS AND FUTURE SCOPE

- ✓ Food matrix-based bioavailability and bioaccessibility of individual pesticides are not studied well
- ✓ Studies report that PRs & TMs degrade during processing due to hydrolysis, oxidation, solubilization, volatilization, thermal breakdown, and metabolites formation but the actual cause for reduction not studied well.
- ✓ Fate of TMs & PRs and their metabolite's interaction with micro and macromolecules during food processing is an another research gap

ACKNOWLEDGEMENT

✓ The first author acknowledges Tamil Nadu Fisheries University (TNFU) for providing facilities and financial support to conduct the research