

## Introduction

Integration of traditional fermented food products to global and national food markets is of great importance for sustainable food security, especially in developing or undeveloped countries. However, product inconsistency, intensive handling during manual practices, use of traditional tools, utensils, and equipment during production, and frequently disregarded hygiene rules and regulations in the production areas are major challenges to the market value of these products. Implementing on-site systematic preventive risk management system will improve the overall level of food safety and quality, and the market value of these products, hence will support food security, and sustainable production.

## Purpose

To propose Failure Mode and Effect Analysis (FMEA) method for:

- quantification of risk analysis of traditional fermented beverages that majority of them are virtually less well known outside of the specific regions of Turkey.
- sustainable production of traditional fermented food products.
- introducing new traditional fermented beverages to both national and global food markets to support the food security of the regions.

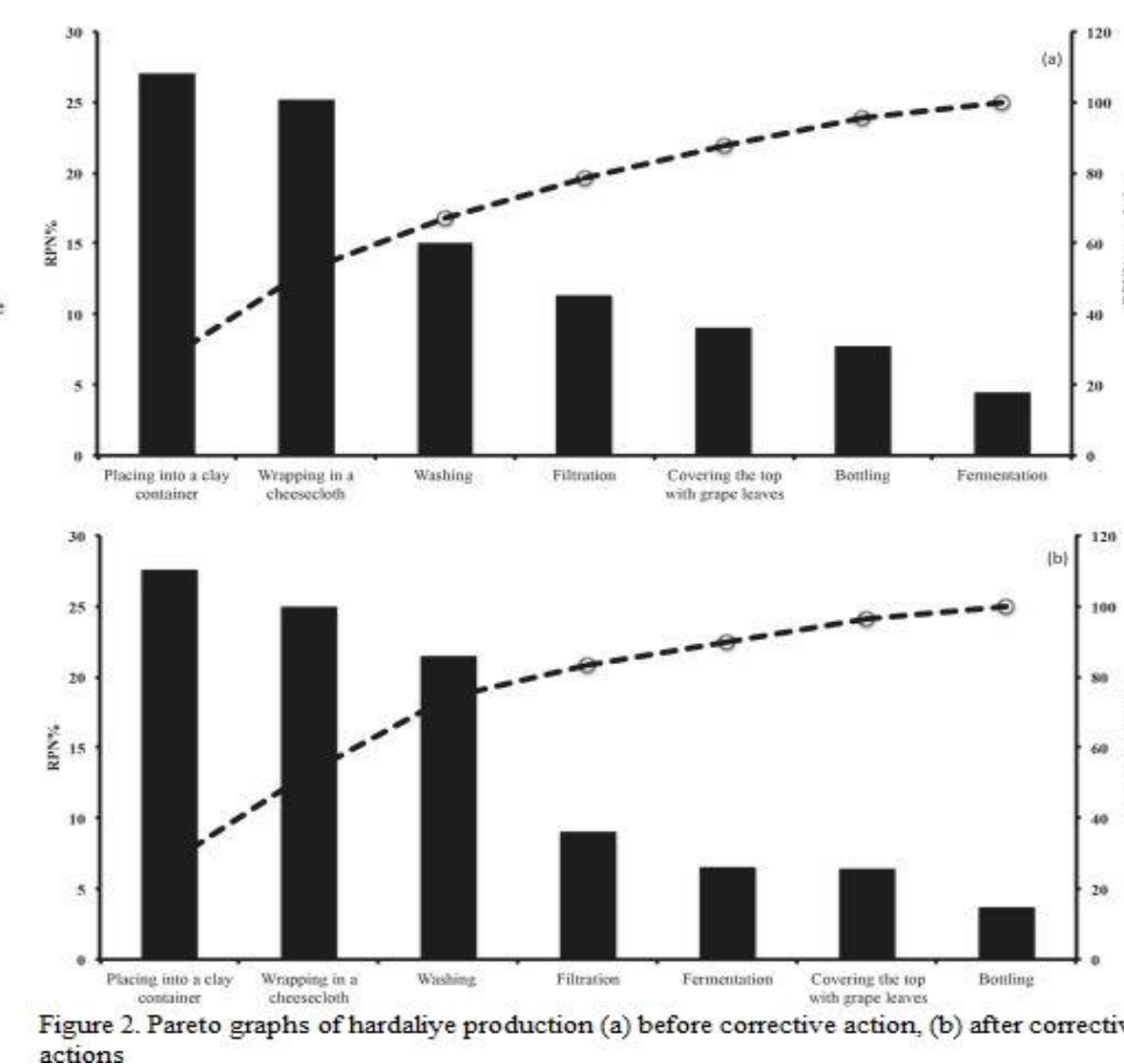
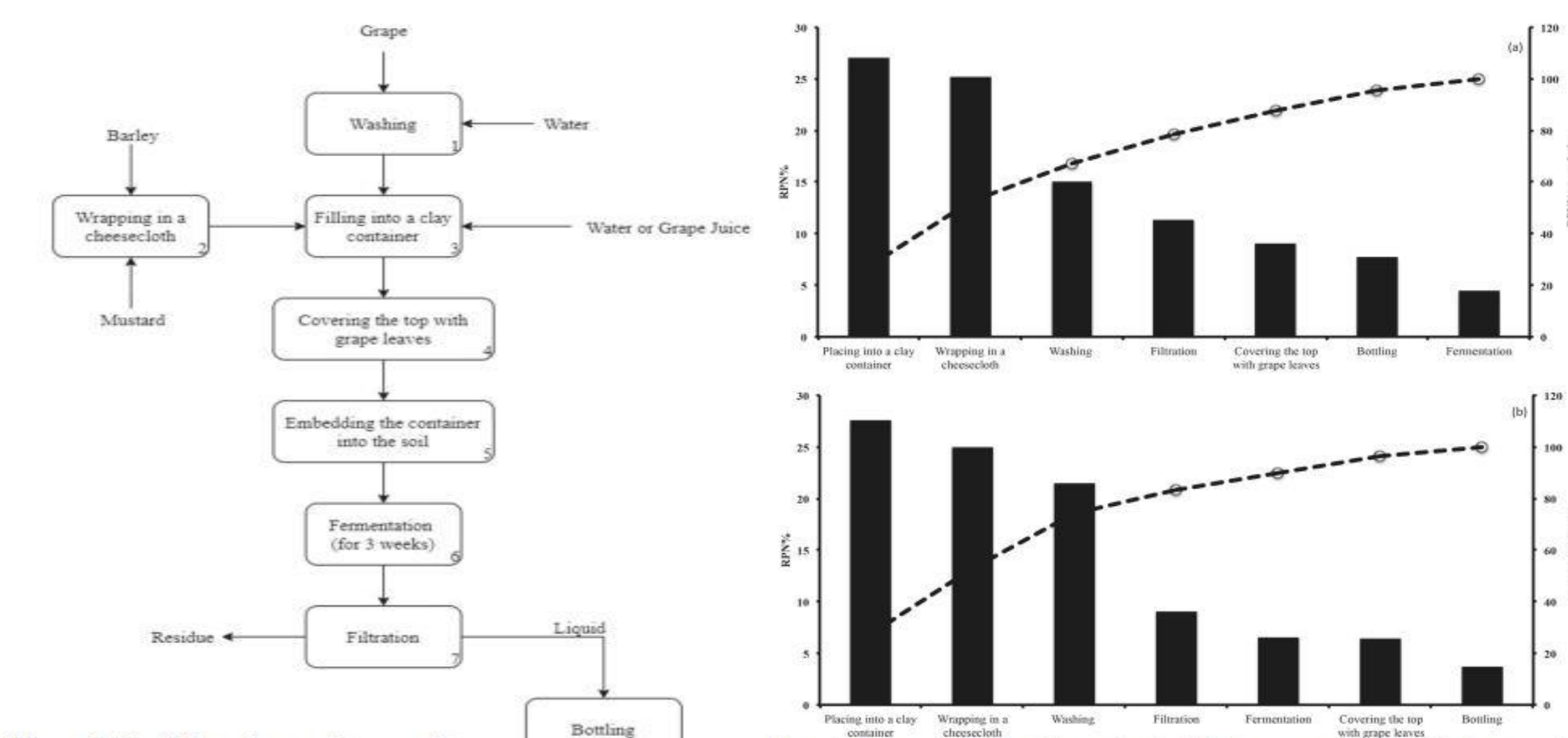


## Methods

The recipes of traditional fermented beverages, which were not commonly known and under risk because of urbanization, modernization, and globalization were collected from the local people, who still produce them at the household level or in small production units, through six years of field studies carried out in different regions of Turkey. Traditional equipment and ingredients, production place and methods, and serving rituals and styles (if any) of each beverage were also recorded. The food safety analyses were carried out in five different areas: (1) human practices, (2) production methods, (3) cleaning practices, (4) environmental control, and (5) storage. A standard checklist and a questionnaire were used to develop the FMEA tables for each product. Possible failure modes and the potential physical, chemical, and biological hazards for each mode were identified, and risk priority numbers (RPN) were calculated. Possible corrective actions were suggested for the failure modes with RPNs higher than 100 and RPNs were recalculated to evaluate their effects on improvement of the process. Sample Pareto graphs were constructed for hardaliye production process, before and after corrective actions.

## Results

In general, high risk priority numbers, ( $RPN \leq 720$ ), were commonly observed in the majority of fermented beverage productions since they were using intensive human handling, implementing obsolete technologies, and employing people that have no training on food hygiene and processing. Implementing FMEA substantially decreased the RPNs for all beverages.



## Discussion

- Depending on the region, wide-range of ingredients such as, milk, grains, plant, cereals, and legumes were used in production of fermented beverages in order to overcome food and nutrition insecurity, as in many parts of the world.
- Obsolete technologies and improper human practices were main causes of process failure.
- Educating the farmers on sanitary quality of milking environment, food hygiene and safety, and safe food handling was the main necessary corrective action to ensure the safety of fermented beverages.
- Majority of local people working in food production was older than sixty.
- The innovative and motivated young generation that can harmonize new technologies with traditional methods to address some of the world's biggest food security challenges is required on farm productions.
- Local people centered, knowledge based support program is required for food security.

## Implications

- Real data collected from the fields over six years were used for the analysis.
- Results from this study may help manufacturers from different parts of the world in producing safer fermented beverages that share common ingredients, equipment, and manufacturing stages.

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