SOCIAL SCIENCE REVIEW ARCHIVES
ISSN Online: 3006-4708
ISSN Print: 3006-4694
https://policyjournalofms.com

Comparative Analysis of Sodium Salt and Potassium Salt for Meat Preservation: Efficacy, Safety, and Quality Impact

Iqra Saddique Masih[1]

[1]University of Lahore, Lahore-Pakistan, Corresponding author: iqrasaddique309@gmail.com,

DOI: https://doi.org/10.70670/sra.v3i1.339

Abstract

The preservation of meat products is a critical aspect of ensuring food safety, extending shelf life, and maintaining quality. While sodium salts have been the traditional choice for meat preservation, increasing concerns about high sodium intake have led to the exploration of potassium salts as alternatives. This study investigates the antimicrobial efficacy, quality retention, and sensory characteristics of sodium chloride and potassium chloride in meat preservation, comparing findings with data from similar studies. The results highlight the potential of potassium salts to serve as a substitute for sodium salts, although challenges related to sensory attributes remain**.**

Keywords: Sodium Salt, Quality, Safety, Analysis of Preservative

Introduction

Meat preservation methods have evolved to address challenges related to microbial spoilage, oxidative rancidity, and quality degradation. Sodium chloride has long been favored for its effective antimicrobial properties and ability to enhance flavor and texture (He et al., 2020). However, excessive sodium consumption is linked to health issues, including hypertension and cardiovascular diseases (World Health Organization, 2013). This has driven interest in potassium chloride as a viable alternative, given its potential health benefits and similar preservation properties (Jones et al., 2020). This study aims to compare the effectiveness of sodium and potassium salts in meat preservation, focusing on microbial inhibition, quality maintenance, and sensory attributes. It also discusses results in the context of existing research to provide a comprehensive understanding of the topic.

Materials and Methods

Experimental Design

Three groups of fresh meat samples were prepared:

Control Group: Untreated meat.

Sodium Salt Group: Treated with 2% sodium chloride (w/w).

Potassium Salt Group: Treated with 2% potassium chloride (w/w).

The samples were vacuum-packed and stored at 4°C for 21 days. Analyses were conducted on days 0, 7, 14, and 21.

Microbial Analysis

Microbial counts were determined using plate count agar for total viable counts (TVC) and selective media for Listeria monocytogenes and Salmonella. Colony-forming units (CFU) were expressed per gram of meat.

Physicochemical Analysis

pH Measurement: Conducted using a pH meter.

Water Holding Capacity (WHC): Evaluated by centrifuging meat samples and measuring water loss.

Texture Profile Analysis (TPA): Performed to assess hardness, springiness, and chewiness using a texture analyzer.

Sensory Evaluation

A panel of 15 trained assessors evaluated sensory attributes, including taste, aroma, and overall acceptability, using a 9-point hedonic scale.

Statistical Analysis

Data were analyzed using one-way ANOVA followed by Tukey’s post-hoc test. Significance was set at $p < 0.05$.

Results and Discussion

Microbial Inhibition

The microbial counts across the three groups are presented in Table 1. Sodium chloride exhibited superior antimicrobial efficacy, reducing microbial loads by approximately 70% by day 21, compared to a 60% reduction with potassium chloride. These findings align with Fritsch et al. (2021), who reported slightly higher inhibitory effects for sodium chloride against Listeria monocytogenes.

Table 1. Sodium chloride exhibited superior antimicrobial efficacy

Day	Control Group (CFU/g)	Sodium Salt Group (CFU/g)	Potassium Salt Group (CFU/g)
0	3.2×10^4	3.0×10^4	3.1×10^4
7	1.1×10^6	4.5×10^5	5.5×10^5
14	2.0×10^6	6.0×10^5	7.2×10^5
21	3.8×10^6	1.2×10^6	1.7×10^6

The table compares microbial counts (CFU/g) in untreated (control), sodium salt-treated, and potassium salt-treated meat samples over 21 days. Key observations are: Day 0 (Baseline): All groups had similar initial microbial levels (~3.0×10^4 CFU/g). Day 7: Sodium salt achieved superior microbial reduction (4.5×10^5 CFU/g) compared to potassium salt (5.5×10^5 CFU/g), with both showing significant improvement over the control group (1.1×10^6 CFU/g). Day 14: Sodium salt continued to exhibit greater efficacy (6.0×10^5 CFU/g), with potassium salt slightly less effective (7.2×10^5 CFU/g). Day 21: Sodium salt maintained its advantage (1.2×10^6 CFU/g), with potassium salt showing slightly higher microbial counts (1.7×10^6 CFU/g), while the control group reached the highest microbial load (3.8×10^6 CFU/g).

Physicochemical Properties

The WHC of potassium chloride-treated meat was slightly higher than sodium chloride-treated meat, consistent with Rühlmann et al. (2022). However, texture analysis revealed a decrease in hardness and springiness for potassium chloride samples, likely due to its lower ionic strength.

Sensory Evaluation

Potassium chloride-treated meat samples exhibited a noticeable bitterness, scoring 5.8 ± 0.4 on the hedonic scale, compared to 7.8 ± 0.3 for sodium chloride samples. These results are consistent with Jones et al. (2020), who noted similar sensory challenges with potassium chloride.

Comparison with Literature

Comparative analysis with existing studies reveals that potassium salts can achieve antimicrobial efficacy comparable to sodium salts when used in similar concentrations (Fritsch et al., 2021; Jones et al., 2020). However, the sensory and textural impacts of potassium salts necessitate further research to optimize formulations and mitigate undesirable characteristics.

Antimicrobial Efficacy

Both sodium and potassium salts exhibit strong antimicrobial properties, inhibiting the growth of pathogens such as Listeria monocytogenes, Escherichia coli, and Salmonella (Rühlmann et al., 2022). Sodium salts have a slightly stronger effect due to their lower water activity, but potassium salts are comparable when used at optimized concentrations.

Impact on Meat Quality

Sodium salts enhance water retention and improve texture and flavor. Potassium salts, while effective, may cause slight bitterness in taste at higher concentrations, which can affect consumer acceptance (Fritsch et al., 2021). Blending sodium and potassium salts has been shown to mitigate sensory differences while maintaining preservative efficacy.

Health Implications

Replacing sodium with potassium salts could help reduce sodium intake and increase potassium consumption, aligning with dietary recommendations (National Institutes of Health, 2019). However, individuals with kidney disorders should exercise caution due to potential hyperkalemia risks.

Consumer Acceptance

Consumer studies indicate mixed responses to potassium salts due to their distinct taste.

However, increasing awareness of the health benefits associated with potassium salts has improved their acceptance in recent years (Jones et al., 2020).

Conclusion

Potassium salts demonstrate significant potential as alternatives to sodium salts in meat preservation, offering comparable antimicrobial effects and health benefits. However, challenges related to sensory properties and texture require further investigation. Future research should focus on developing blends of sodium and potassium salts to enhance preservation efficacy while maintaining sensory appeal.

Acknowledgment:

The author would like to thank the University of Lahore for their excellent support for the submission of the article.

References

Fritsch, J. R., et al. (2021). "Impact of salt type on sensory and microbiological properties of processed meat products." Meat Science, 180, 108576. https://doi.org/10.1016/j.meatsci.2020.108576

He, F. J., et al. (2020). "Salt reduction and cardiovascular disease: a review of the evidence." Nature Reviews Cardiology, 17(6), 370-377. https://doi.org/10.1038/s41569-019-0244-0

Jones, N. R. V., et al. (2020). "Consumer acceptance of reduced-sodium and potassium-enriched food products: A review." Appetite, 144, 104452. https://doi.org/10.1016/j.appet.2019.104452

Rühlmann, C., et al. (2022). "Comparison of sodium and potassium salts in meat preservation: Microbial and quality assessments." Food Microbiology, 102, 103920. https://doi.org/10.1016/j.fm.2021.103920

World Health Organization (2013). "Sodium intake for adults and children: Guideline." World Health Organization. https://www.who.int/publications/i/item/9789241504836

National Institutes of Health (2019). "Dietary guidelines for sodium and potassium intake." https://www.nhlbi.nih.gov