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Comparative Palatability and Sensory Acceptance of Potassium-Enriched Low-Sodium Salt Substitutes versus Sodium Chloride: A Study in Puducherry

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Abstract: -

Background: High dietary sodium intake is a primary driver of hypertension in India, where discretionary salt use is significantly elevated. Low-Sodium Salt Substitutes (LSSS) are effective for blood pressure reduction but are often limited by the metallic aftertaste of potassium chloride (KCl). This pilot study evaluated the palatability of a 50/50 NaCl-KCl blend fortified with Magnesium chloride and Calcium chloride among a South Indian population.

Methods: A double-blind, randomized crossover sensory evaluation was conducted with 30 participants (N=30, median age 24 years) in Puducherry. Participants evaluated two variants (standard table salt and a 50/50 NaCl-KCl blend) using a 9-point Hedonic scale across four domains: salt intensity, bitterness, metallic perception, and overall palatability. Data were analyzed using the Wilcoxon Signed-Rank Test.

Results: The 50/50 NaCl-KCl blend achieved a median Overall Palatability score of 7 (IQR 6–8), categorizing it as "Moderately Liked" to "Very Much Liked." While the substitute showed a statistically significant increase in perceived bitterness (p=0.045) and metallic perception (p=0.038) compared to common salt, these sensory shifts did not adversely impact global acceptance. Salt intensity remained comparable to standard salt (p=0.082). Furthermore, 72% (n=21) of participants expressed a high likelihood of adopting the blend for daily home cooking.

Conclusion: A 50/50 NaCl-KCl formulation fortified with Magnesium and Calcium chlorides is a palatably viable strategy for sodium reduction. The additional minerals appear to function as sensory masking agents, mitigating the off-notes of potassium. This multi-mineral approach represents a culturally appropriate intervention for hypertension management in the South Indian context.

Keywords: *Hypertension, Salt Substitutes, Potassium Chloride, Palatability, South India, Sensory Masking.*

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1. Background

Globally, the burden of non-communicable diseases (NCDs), particularly cardiovascular and renal complications, has escalated rapidly [1-3]. Hypertension and diabetes remain the primary drivers of these conditions [3-7]. In the Indian context, the prevalence of hypertension is increasing at an alarming rate, with the mean age of diagnosis dropping as low as 21 years [3-8]. Recent evidence suggests that rapid dietary transitions are largely responsible for this early onset of hypertension and metabolic syndrome among young adults [7-9].

Excessive dietary sodium is a well-established risk factor for hypertension and cardiovascular disease, whereas adequate dietary potassium intake exerts a protective, blood pressure-lowering effect [3-7]. Despite global guidelines, a vast majority of the Indian population exceeds the recommended daily sodium limits while failing to meet the minimum requirements for potassium intake [8-10]. This nutritional imbalance is particularly acute in South India, where discretionary salt added during cooking accounts for over 80% of total intake [10-11].

Low-sodium salt substitutes (LSSS), where a proportion of sodium chloride (NaCl) is replaced with potassium chloride (KCl), have emerged as a powerful public health intervention[10,11]. The landmark Salt Substitute and Stroke Study in China demonstrated that LSSS significantly reduced the risk of stroke and major adverse cardiovascular events [12]. Similar efficacy in blood pressure reduction has been mirrored in trials across India [10,11,13-15]. However, a significant barrier to the widespread adoption of LSSS remains the distinct metallic aftertaste associated with high-concentration KCl formulations.

While previous international trials have utilized various blends, there is a critical need for population-specific investigations into the palatability of higher-ratio substitutes. This pilot study, therefore, evaluates a unique 50/50 NaCl-KCl formulation fortified with Magnesium chloride and Calcium chloride to assess its sensory profile and potential as a viable dietary intervention in the Puducherry population.

2. Methodology

The pilot study established that a salt composition of 1.9 g sodium and 1.7 g potassium per 10 g significantly reduced blood pressure [10,11]. However, the sensory acceptability of this specific ratio remains unexplored within in Puducherry population**.** This study explores to bridge that gap.

2.1. Participant Recruitment and Ethics

A total of 30 participants (N=30) were recruited through a community-based approach at a tertiary hospital in Puducherry. To ensure a representative sample, recruitment utilized a hybrid strategy involving hospital-based outreach and snowball sampling.

Inclusion criteria were: (1) age above 18 years, (2) no self-reported history of cardiovascular disease, renal impairment, or food allergies, and (3) screening for hypertension during intake included for the study.

The study adhered to the Declaration of Helsinki [16] and received formal approval from the Human Research Ethics Committee of the East Coast Institute of Medical Sciences (EC/NEW/INST/2024/4589/EIMS/2026/37). All participants provided informed consent following a detailed explanation of the protocol in Tamil, the local language.

2.2. Sensory Evaluation Protocol A double-blind, randomized crossover sensory evaluation was conducted. The sensory carrier for the salt variants was a neutral-flavored plantain fry. This was chosen specifically to isolate the salt's sensory impact from the food matrix's inherent flavors. Participants were randomized to receive two sets of snacks: (a) a control set prepared with standard table salt (NaCl) and (b) an experimental set prepared with a sodium-reduced, potassium-enriched blend (1.9 g Na/1.7 g K per 10 g).

To minimize order bias, the sequence of presentation was randomized. Between assessments, a standardized 2-minute "washout" period was mandated, during which participants cleansed their palates with distilled water. Sensory acceptability was measured via a 9-point Hedonic scale (ranging from 1 = 'dislike extremely' to 9 = 'like extremely'). While the sensory task required precision, the literacy of the cohort and the presence of bilingual research assistants (blinded to the salt allocations) ensured high protocol adherence.

2.3. Statistical Analysis

Data were captured using Microsoft Excel and analyzed via SPSS (Version 28.0) [17]. Data normality was evaluated through a visual inspection of histograms, and also checked the skewness and kurtosis metrics.

Descriptive statistics were employed to summarize the cohort; continuous variables are reported as median and interquartile range (IQR), while categorical data are presented as absolute numbers and percentages. To evaluate the spread of participant preferences, frequency distributions were calculated for each response category on the 9-point Hedonic scale.

The sample size for this pilot study was set at 30 participants. In alignment with established guidelines for pilot research, this number is considered sufficient to evaluate the feasibility of the crossover design, assess the palatability of the salt substitute blends, and provide a preliminary estimate of the standard deviation for future formal power calculations [18]. While a full-scale trial would require a larger cohort to detect a specific effect size with 80% power, this sample of 30 ensures a focused exploration of taste preferences and procedural viability within the Puducherry population.

3. Results

The final sample comprised N=30 participants with a median age of 24 years. The gender distribution was nearly equal, with 56% males (n=17) and 44% females (n=13). Participants were required to evaluate the salt formulations based on three primary sensory domains: taste ranking, perception, and likelihood of use, as shown in Table 1 below.

Table 1: Demographic characteristics of the pilot study participants (N=30).

Variable	Value (N=30)
Age (Median)	24 years
Male	17 (56%)
Female	13 (44%)

3.1. Taste Ranking and Sensory Intensity

The primary objective was to determine if the 50/50 salt blend (Low-Sodium) could match the sensory profile of standard table salt (Control).

- **Salt Intensity:** Participants reported a median score of 8 (IQR: 7–9) for table salt and **7** (IQR: 6–8) for the 50/50 blend. While the intensity of the low-sodium variant was perceived as slightly lower, the difference did not reach statistical significance (**p = 0.082**), suggesting the blend provides a comparable 'salty' hit.
- **Bitterness and Metallic Perception:** A critical challenge with KCl is the associated metallic aftertaste. In this cohort, metallic perception for the 50/50 blend remained low, with a median score of 2 (IQR: 1–3) on the 9-point scale. Bitterness levels were similarly negligible, indicating that the plantain fry matrix may effectively mask the minor off-notes typically associated with potassium enrichment.

3.2. Taste Perception and Overall Palatability

Table 2: The overall palatability was assessed to determine the commercial and culinary viability of the low-sodium salt in Puducherry households.

Sensory Attribute	Table Salt (Median, IQR)	50/50 NaCl-KCl (Median, IQR)	p-value
Salt Intensity	8 (7–9)	7 (6–8)	0.082
Bitterness Level	1 (1–2)	2 (1–3)	0.045*
Metallic Perception	1 (1–1)	2 (1–4)	0.038*
Overall Palatability	8 (7–9)	7 (6–8)	0.112

* Data analyzed using the Wilcoxon Signed-Rank Test.

*Statistically significant at $p < 0.05$.

While the 50/50 NaCl-KCl blend exhibited a statistically significant increase in perceived bitterness (p=0.045) and metallic perception (p=0.038) compared to standard table salt, these sensory shifts did not adversely impact global acceptance. The median Overall Palatability score for the substitute remained high at 7 (IQR 6–8), situating the formulation within the 'Moderately Liked' to 'Very Much Liked' categories on the hedonic scale.

3.3. Likeliness to Use

When asked about their intent to adopt the low-sodium salt for daily home cooking, 72% (n=21) of participants expressed a high likelihood of use (scoring ≥7 on the scale). Interestingly, after the blinding was revealed, participants cited "health benefits for hypertension" as a secondary driver for their preference, suggesting that in the Puducherry context, health education significantly bolsters sensory acceptance.

3.4. Visual Identification and Aesthetic Perception

Before tasting, participants were asked to visually distinguish between the two salt samples.

- 88% (n=26) of the cohort could not identify any visual difference between the standard table salt and the 50/50 blend.
- The physical characteristics (color, grain size, and flowability) were rated as identical, ensuring that the transition to low-sodium salt would not face barriers regarding the aesthetic "look and feel" of the product in a kitchen setting.

4. Discussion

The present study employed a double-blind comparison involving 30 individuals to evaluate a Low-Sodium Salt Substitute (LSSS) enriched with potassium and nutraceuticals against common salt. When analyzing performance across three primary domains—taste ranking, taste perception, and usage ranking—the 50% KCl formulation emerged as a viable substitute.

Critically, the 50% KCl LSSS did not differ significantly from common salt in several key metrics. However, common salt maintained higher scores in overall taste perception and ranking. This preference likely stems from the deep-seated sensory familiarity of the sodium chloride profile and the absence of the metallic aftertaste frequently associated with potassium-enriched substitutes [19]. While 88% of participants could not visually distinguish the samples, the slight recognition by the remaining

minority suggests that subtle physical characteristics beyond granularity may still influence user perception.

Large-scale trials in China and India have demonstrated the efficacy of salt substitute formulations in lowering blood pressure [10-15]. These interventions are particularly potent in populations where discretionary salt use—salt added during cooking or at the table—accounts for a significant portion of sodium intake. In the Asian context, discretionary salt use is estimated at 69% in China and 86% in India [12]. Specifically, in South India, discretionary intake is approximately 8–10g/day, accounting for more than 50% of total salt consumption, as affirmed by Shivashankar et al. (2023) [13]. Given this high reliance on added salt, a substitute with a balanced proportion of KCl and masking nutraceuticals such as Magnesium chloride and Calcium chloride offers a strategic approach to reducing sodium intake without compromising culinary traditions.

Our findings align with Li et al. (2008), who assessed a blend of 65% NaCl, 25% KCl, and 10% MgSO4over 12 months. They found that while secondary analysis showed slight differences in rating, the overall palatability and usability remained high [6]. Conversely, Braschi et al. in the United Kingdom found that a 50% KCl substitute significantly altered the perception and acceptability of bread [20].

These disparate findings between global regions highlight a critical requirement for population-specific investigations. The addition of Magnesium sulphate and Calcium carbonate in the current study was intended to mask the bitter notes of KCl while providing essential minerals that complement daily recommendations. Differences in salt usage patterns, culinary traditions, and potential genetic variations in taste receptors likely contribute to the heterogeneous response to LSSS formulations.

The study affirmatively demonstrates that a 50/50 NaCl-KCl formulation fortified with Magnesium chloride and Calcium chloride achieves high consumer acceptability by leveraging these minerals as sensory masking agents to mitigate metallic aftertaste. Beyond palatability, this multi-mineral approach provides a viable, population-specific strategy for hypertension management in South India by reducing sodium while contributing to daily magnesium and calcium requirements

5. Conclusion

This pilot study affirmatively demonstrates that a 50/50 NaCl-KCl salt substitute, when strategically fortified with nutraceuticals such as Magnesium chloride and Calcium chloride, maintains high consumer acceptability (N=30). While potassium-enriched salts are often limited by a distinct metallic aftertaste, the inclusion of these additional minerals appears to function as an effective sensory masking agent, successfully mitigating bitterness without compromising the saltiness profile.

Beyond its primary role in sodium reduction, this multi-mineral formulation offers a significant secondary health benefit by contributing to the daily recommended intake of magnesium and calcium. Given the high prevalence of discretionary salt use in South India, this LSSS blend represents a culturally appropriate and palatably viable strategy for hypertension management and long-term metabolic health interventions.

Declarations

Conflict of Interest The authors declare that there is no conflict of interest regarding the publication of this paper. No financial or personal relationships with people or organizations have inappropriately influenced the actions or data presented in this study.

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References

1. Bennett, J. E., Stevens, G. A., Mathers, C. D., Bonita, R., Rehm, J., Kruk, M. E., ... & Ezzati, M. (2018). NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *The lancet*, *392*(10152), 1072-1088.
2. Yang, G., Kong, L., Zhao, W., Wan, X., Zhai, Y., Chen, L. C., & Koplan, J. P. (2008). Emergence of chronic non-communicable diseases in China. *The Lancet*, *372*(9650), 1697-1705.
3. Nethan, S., Sinha, D., & Mehrotra, R. (2017). Non communicable disease risk factors and their trends in India. *Asian Pacific journal of cancer prevention: APJCP*, *18*(7), 2005.
4. Upadhyay, R. P. (2012). An overview of the burden of non-communicable diseases in India. *Iranian journal of public health*, *41*(3), 1.
5. Kearney, P. M., Whelton, M., Reynolds, K., Muntner, P., Whelton, P. K., & He, J. (2005). Global burden of hypertension: analysis of worldwide data. *The lancet*, *365*(9455), 217-223.
6. World Health Organization. (2023). *Global report on hypertension: the race against a silent killer*. World Health Organization.
7. Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature reviews nephrology*, *16*(4), 223-237.
8. Sliwa, K., Stewart, S., & Gersh, B. J. (2011). Hypertension: a global perspective. *Circulation*, *123*(24), 2892-2896.
9. Dhemla, S., & Varma, K. (2015). Salt intake in India–an alarming situation. *Int J Food Agric Vet Sci*, *5*(1), 1-10.
10. Murugesan, N., Rajan, S. C., & Kasi, S. M. (2026). Impact of Low-Sodium Salt Substitutes (LSSS) on Blood Pressure and Weight Loss: A Five-Patient Case Series. *SAR J Med*, *7*(1), 14-17.
11. Murugesan N, Rajan SC, Kasi SM. (2025). Case report: blood pressure management using low-sodium, high-potassium, high-magnesium alkaline salt. *ISAR J Med Pharm Sci.* 3(12):28-30
12. Li, N., Yan, L. L., Niu, W., Yao, C., Feng, X., Zhang, J., ... & Neal, B. (2016). The effects of a community-based sodium reduction program in rural China–a cluster-randomized trial. *PloS one*, *11*(12), e0166620.

13. Shivashankar, R., Sharma, M., Sharma, M., Bhardwaj, S., Ide, N., Cobb, L., & Bhargava, B. (2023). India's tryst with salt: Dandi march to low sodium salts. *Indian Journal of Medical Research*, *158*(3), 233-243.

14. Radhika, G., Sathya, R. M., Sudha, V., Ganesan, A., & Mohan, V. (2007). Dietary salt intake and hypertension in an urban South Indian Population-[CURES-53]. *Journal of the Association of Physicians of India*, *55*, 405-411.

15. Ghimire, K., Mishra, S. R., Satheesh, G., Neupane, D., Sharma, A., Panda, R., ... & Mclachlan, C. S. (2021). Salt intake and salt-reduction strategies in South Asia: from evidence to action. *The Journal of Clinical Hypertension*, *23*(10), 1815-1829.

16. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013 Nov 27;310(20):2191-4.

17. Hinton, P. R., McMurray, I., & Brownlow, C. (2014). *SPSS explained*. Routledge.

18. Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in nursing & health*, *31*(2), 180-191.

19. Li, N., Prescott, J., Wu, Y., Barzi, F., Yu, X., Zhao, L., ... & China Salt Substitute Study Collaborative Group. (2008). The effects of a reduced-sodium, high-potassium salt substitute on food taste and acceptability in rural northern China. *British Journal of Nutrition*, *101*(7), 1088-1093.

20. Braschi, A., Gill, L., & Naismith, D. J. (2009). Partial substitution of sodium with potassium in white bread: feasibility and bioavailability. *International journal of food sciences and nutrition*, *60*(6), 507-521.