

# Effect of salt distribution heterogeneity on enhancing perception of saltiness and sensory properties in beef patties

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**Objective:** Contrast stimuli created between high- and low- flavour concentration zones has been shown to enhance the perception of sensory trait intensity (Thomas-Danguin et al., 2019). Previous research has explored this phenomenon in diverse foodstuffs, using different strategies (Monteiro et al., 2021, Xiong et al., 2020, Gaudette et al., 2019). The objective of the present study was to determine if layering beef formulations with contrasting salt content into salt-heterogeneous burger patties could evoke a more intense perception of flavours, compared to a burger matched in overall salt content but with homogeneous salt distribution.

**Materials and Methods:** One patty batch with homogeneous salt distribution (0.7% NaCl HMG) and six patty batches with average NaCl content of 0.7%, but distributed in six different heterogeneous (HTG) salt structures (HTG\_3L\_EX, HTG\_3L\_IN, HTG\_4L\_EX, HTG\_4L\_IN, HTG\_5L\_EX, HTG\_5L\_IN) were formulated. For each formulation, salt was added to either the internal (IN) or external (EX) part of the burger with a view to creating contrast stimuli and evocation of higher taste bud response. The composition of beef patties varied in concentration and volume of each layer (L). Salt content varied between 0% added and 2.1% added per layer, and the volume (proportion) of layers was varied accordingly to achieve overall similar salt content in all formulations with a final patty weight of 170g. Beef patties were grilled to 75°C (FSAI, 2018), wrapped in foil, coded, and immediately served to trained assessors (n=8) in a sequential monadic order according to a randomised design. Sensory profiling using Quantitative Descriptive Analysis was carried out in accordance with ISO 13299:2016 and AMSA (2015) guidelines. Nine sensory attributes (beef odour, hardness, juiciness, beef flavour, salty and umami tastes, uniformity of taste, beef and salty aftertastes) were assessed on an unstructured linear graphic scale with specific word anchors. Proximate analysis was also conducted using AOAC methods.

**Results and Discussion:** Heterogeneity of salt in beef patties produced significant differences ( $p \leq 0.05$ ) among formulations in intensity of salty taste, salty and beef aftertaste, as well as taste uniformity. Significant differences were also noted in hardness and juiciness among formulations. Analysis did not show differences in beef odour, flavour, or umami taste. Increased intensity of saltiness was perceived when higher salt was located within internal burger layers (IN). Saltiness of HTG\_4L\_IN sample was significantly ( $p < 0.05$ ) higher than the HMG patty. Placing the salt in external layers increased the perceived hardness of beef burgers but did not enhance the perception of saltiness or other traits. Samples with equal proportion of salted (1.4% NaCl) and unsalted meat were perceived as having a more intense beef aftertaste. Analysis of proximate composition of burgers revealed that raw burgers did not differ in moisture, protein, or fat content. Furthermore, none of the HTG samples differed in ash or salt content from the HMG patty. One pairwise comparison was significant with two HTG formulations (HTG\_5L\_IN and HTG\_3L\_IN) differing from each other. With regard to the product at point of consumption (cooked burgers), there was no significant differences in salt content between any formulations. Lowering the level of salt added to food products is an important strategy for improving public health. The use of salt agglomerates (Monteiro et al., 2021) or encapsulated salt (Beck et al., 2021) has been tested for relevance to inducing enhanced sensory stimulation via taste contrast stimuli. Our research suggests an alternative approach involving preparing burgers with layers of varied salt concentration could increase the burger consumption sensory experience, while potentially facilitating lower salt inclusion levels.

## References:

1. Thomas-Danguin, T. et al. (2019). Cross-modal interactions as a strategy to enhance salty taste and to maintain liking of low-salt food: a review. *Food & Function*, 10(9), 5269-5281.
2. Beck, P. H. B. et al (2021). Sodium chloride reduction in fresh sausages using salt encapsulated in carnauba wax. *Meat Science*, 175, 108462.
3. Food Safety Authority of Ireland (FSAI) 2018. Advice for Caterers on Serving Burgers that are Safe to Eat. *General Fact Sheet Series*, Issue No 4, July 2018
4. Gaudette, N. J. et al (2019). Application of taste contrast to enhance the saltiness of reduced sodium beef patties. *LWT*, 116, 108585.
5. Monteiro, A. R. G., et al (2021). Increasing saltiness perception and keeping quality properties of low salt bread using inhomogeneous salt distribution achieved with salt agglomerated by waxy starch. *LWT*, 146, 111451.
6. Xiong, Y., Deng, B., Warner, R. D., & Fang, Z. (2020). Reducing salt content in beef frankfurter by edible coating to achieve inhomogeneous salt distribution. *International Journal of Food Science & Technology*, 55(8), 2911-2919.

**Key words:** Contrast stimuli, Product reformulation, Sensory, Beef patties