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Research on the preservation of green tomatoes through different fermentation processes

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Abstract: *Green tomatoes left on the plants at the end of the growing season can be valorised through preservation. The study tested whether Himalayan salt and apple cider vinegar with honey are suitable for preserving green tomatoes, compared with sea salt and spirit vinegar. Four mixed acidification treatments and two spontaneous lactic fermentation controls, all with 1.5% salt in the covering liquid, were prepared in 2022–2023 at USAMV Cluj-Napoca and evaluated by a preliminary panel of 23 consumers. Taste was named most often as the most important quality attribute (30–32% of respondents), followed by aroma (21–24%). The product with Himalayan salt and apple cider vinegar with honey was perceived as less salty than similar market products by 70% of the respondents (50% for sea salt and spirit vinegar), and 80% found its salinity adequate.*

Keywords: *Solanum lycopersicum*, lactic acid bacteria, mixed acidification, Himalayan salt, apple cider vinegar, sensory analysis

• Introduction

Lactic fermentation, carried out by lactic acid bacteria, extends shelf life and gives pickles their specific flavour. Product quality depends on temperature, pH, salt concentration and the microbiota present [1, 2]. In mixed acidification the vegetables are first lactic-fermented, then covered with a vinegar solution and pasteurised.

Green tomatoes left on the plants at the end of the season are often an unused residue. Consumers also show growing interest in ingredients perceived as natural, such as pink Himalayan salt [3] and apple cider vinegar, which has a lower acidity and a more complex aroma than spirit vinegar [4]. The aim was to check whether these two ingredients suit preserved green tomatoes, judged by consumer perception.

• Material and method

The experiment was carried out in 2022–2023 in the laboratory of the Technology of Horticultural Products discipline, USAMV Cluj-Napoca. The fruits were washed, sorted, sized with a calliper, sliced, seasoned and packed into jars, which were filled with the covering liquid of each treatment (Table 1, Figure 1). Salt was used at 1.5% in the covering liquid; 9% and 5% are the declared acidities of the commercial vinegars. Each treatment was prepared in three jars per year.

A preliminary panel of 23 untrained consumers, women and men [5], named for each treatment the sensory attribute most important for quality. Treatments b1 and b4 were then compared through multiple-choice questions on salinity and aroma. The results are descriptive; no statistical test was applied.

Table 1. Experimental treatments

Treatment	Salt (1.5%)	Vinegar (declared acidity)	Process
b1	sea salt	spirit vinegar, 9%	mixed acidification
b2	sea salt	apple cider vinegar with honey, 5%	mixed acidification
b3	Himalayan salt	spirit vinegar, 9%	mixed acidification
b4	Himalayan salt	apple cider vinegar with honey, 5%	mixed acidification
C1	sea salt	–	lactic fermentation (control)
C2	Himalayan salt	–	lactic fermentation (control)

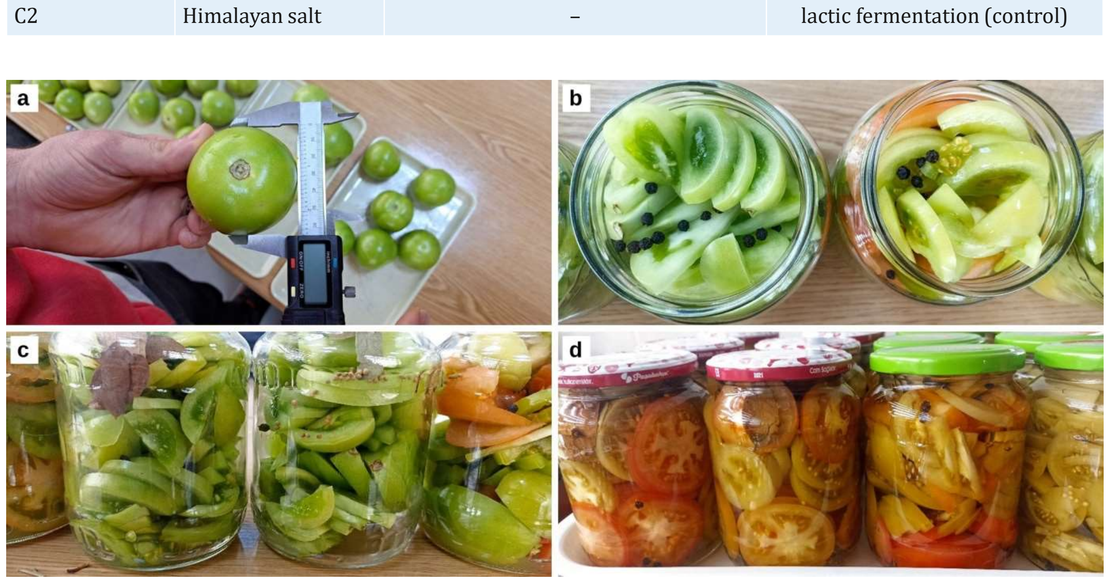


Figure 1. Preparation of preserved green tomatoes: a – sizing with a calliper; b – sliced and seasoned tomatoes; c – tomatoes in jars before covering; d – jars prepared for fermentation (original)

• Results and discussions

Taste was named most often as the most important attribute for all treatments and both sexes (30–32% of respondents), followed by aroma (21–24%) (Table 2). The clarity of the covering liquid was named least often (7–10%). Women named colour (20–22%) more often than texture (17–18%); men named texture more often for b1, b3, C1 and C2, and colour more often for b2 and b4. Values for one attribute differed by at most 4 percentage points between treatments.

In the direct comparison (Figure 2), 70% of the respondents rated b4 less salty than similar commercial products, against 50% for b1. For b4, 80% found the salinity adequate, 10% too low and 10% could not assess it, and 50% described its aroma as subtle and delicate (40% for b1). Because b1 and b4 differ in both salt and vinegar, the milder salinity cannot be put down to one ingredient: the lower acidity of the cider vinegar, the honey and the slightly lower sodium content of Himalayan salt may all play a part [3, 4]. Half of the respondents named raw material quality as the decisive factor for taste and texture.

Table 2. Relative importance of sensory attributes (% of respondents naming the attribute as the most important; women / men)

Treatment	Taste	Aroma	Colour	Texture	Clarity
b1	30 / 32	21 / 22	22 / 16	18 / 20	9 / 10
b2	31 / 32	23 / 22	21 / 20	17 / 17	8 / 9
b3	32 / 32	24 / 22	20 / 16	17 / 20	7 / 10
b4	32 / 32	24 / 24	20 / 20	17 / 16	7 / 8
C1	30 / 32	24 / 22	20 / 16	17 / 20	9 / 10
C2	30 / 32	24 / 22	20 / 16	18 / 20	8 / 10

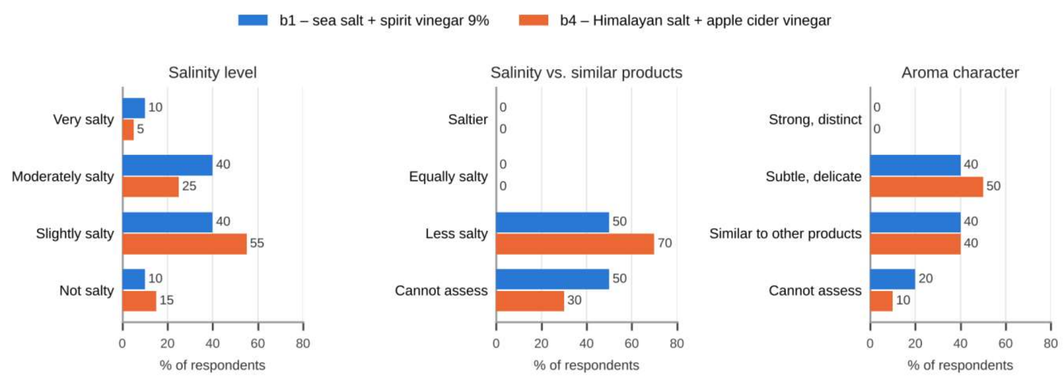


Figure 2. Perception of salinity and aroma for b1 and b4 (% of the 23 respondents, rounded to the nearest 5%)

• Conclusions

Green tomatoes can be valorised by both spontaneous lactic fermentation and mixed acidification, with a covering liquid containing 1.5% salt.

Taste, followed by aroma, decides how consumers judge the preserved product, so the salinity and acidity of the covering liquid need the most attention.

Himalayan salt with apple cider vinegar and honey gave a product with a milder perceived salinity, a good starting formulation for small-scale processing.

The results are preliminary. Measurements of pH, titratable acidity and NaCl and a trained sensory panel are needed to confirm them.

Selected references

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