UNIVERSITY OF LIFE SCIENCES ”KING MIHAI I” FROM TIMISOARA
”YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH IN APPLIED LIFE SCIENCES”

5-6 November 2026



”Young people and multidisciplinary research in applied life sciences”

Ginger (*Zingiber officinale* Roscoe) as a Natural Antioxidant in Cooked Pork Offal Sausage: Lipid Oxidation, pH and Color Stability during Refrigerated Storage

Bolosin (căs. Tonța) Alina, Costoae (căs. Dâlv) Diana Maria, Jianu Călin, Cocan Ileana*
Faculty of Food Engineering, University of Life Sciences "King Mihai I" from Timisoara, Calea Aradului 119, Timișoara 300645, România
*ileanacocan@usvt.ro

Abstract:
The paper analyzes the use of ginger as a natural antioxidant in cooked pork products. Lipid oxidation is one of the main causes of quality loss in thermally processed meat products: it produces off-odors and off-flavors, changes color and lowers nutritional value. Consumer demand for products with fewer synthetic additives has pushed the meat industry to look for plant-derived alternatives to antioxidants such as BHA and BHT.
Spice extracts rich in phenolic compounds, such as rosemary, oregano, thyme and ginger, keep part of their activity after boiling or baking. In cooked beef, spices of medium antioxidant potency work at about 0.5% of product mass, and spice extracts at 2.5% have shown activity equal to or higher than BHA and propyl gallate used at 0.02%.
Ginger (Zingiber officinale Roscoe) contains gingerols, shogaols, paradols and zingerone, with 6-gingerol as the main antioxidant compound. These compounds scavenge free radicals, chelate pro-oxidant metal ions and inhibit lipoxygenase, and ginger extracts also inhibit Staphylococcus aureus, Escherichia coli, Salmonella Typhimurium and Listeria monocytogenes. In meat products ginger is used mostly as a powder, at 0.5–2%.
The main objective of this study was to evaluate the effect of ginger on the oxidative stability of cooked pork offal sausage, a traditional Romanian product made from pork head meat, back fat, offal, rind and rice. Two samples were produced: a control made to the basic recipe and a sample with 1% dried ginger powder. The raw materials were boiled at 90–95 °C, minced through an 8–10 mm plate, mixed with sautéed onion, broth, salt, pepper and ginger, stuffed into natural casings and cooked at 75–80 °C to a core temperature of at least 70 °C. Both samples were stored at 2–4 °C for 7 days.
*Moisture, protein, fat, NaCl and ash were determined by standard methods, carbohydrates and energy value were calculated according to Regulation (EU) No 1169/2011, and fat freshness was checked with the Kreiss reaction. Lipid oxidation (TBA test), pH and CIE L*a*b* color were measured on days 1, 3 and 7, and 8 trained panelists rated the samples on a 10-point hedonic scale. The ginger sample contained 58.43% moisture, 17.92% protein, 21.15% fat and 2.76% NaCl, within the limits of Romanian Order No. 210/2006, and the Kreiss reaction was negative. TBA values rose in both samples during storage but were 35.8% lower in the ginger sample on day 3 and 32.5% lower on day 7. pH fell by 0.10 units in the ginger sample and by 0.21 units in the control. Lightness (L*) dropped by 3.28 units with ginger and by 6.18 units without it, and the total color change on day 7 was ΔE* = 4.63 in the ginger sample and 8.17 in the control. The panel gave the ginger sample higher scores for odor (8.3 vs. 7.6), taste (8.0 vs. 7.2) and overall acceptability (8.1 vs. 7.4), with identical scores for consistency.*
The results show that 1% ginger powder slows lipid oxidation, acidification and color change in cooked pork offal sausage during refrigerated storage and improves its odor and taste, which supports its use as a natural antioxidant in cooked meat products. One panelist found the pungency slightly strong, so lower levels (0.7–0.8%) are worth testing.
Keywords: *natural antioxidants, ginger, lipid oxidation, TBA, cooked pork offal sausage*

Introduction

Lipid oxidation is one of the main causes of quality loss in thermally processed meat products. It produces rancid odors and off-flavors, changes color and lowers nutritional value. Consumers ask for products with fewer synthetic additives, so the meat industry is replacing antioxidants such as BHA and BHT with plant-derived alternatives. Spices rich in phenolic compounds (rosemary, oregano, thyme, ginger) keep a large part of their activity after boiling or baking.

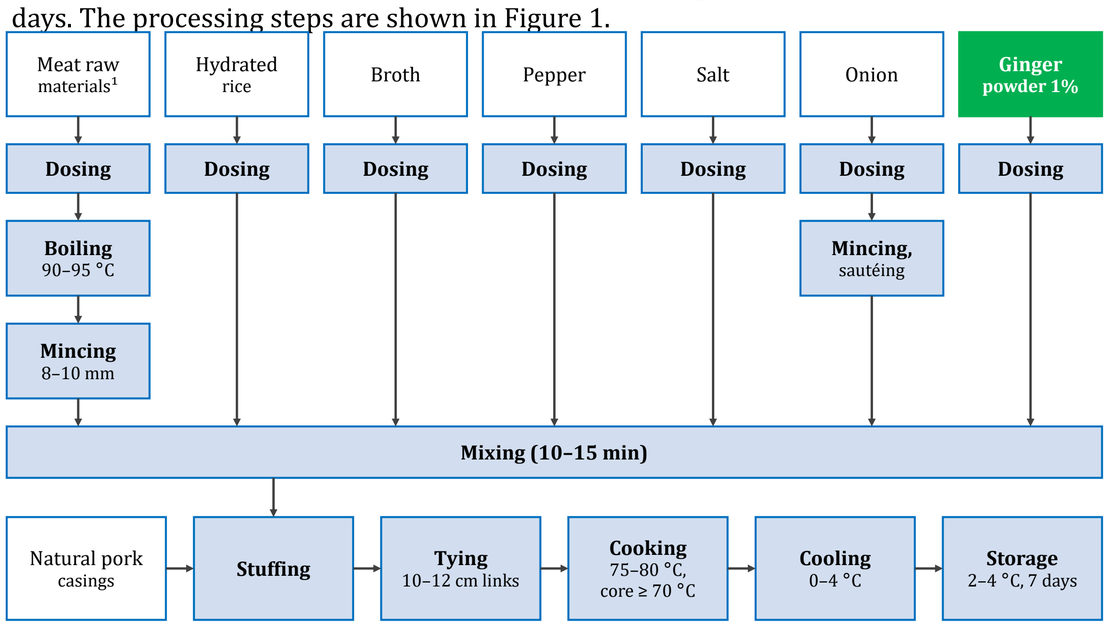
Ginger (*Zingiber officinale* Roscoe) is a perennial herb of the Zingiberaceae family. Its rhizome contains gingerols, shogaols, paradols and zingerone, and 6-gingerol is the main antioxidant compound. These compounds scavenge free radicals, chelate pro-oxidant metal ions (Fe^{2+}, Cu^{2+}) and inhibit lipoxygenase. During heating, part of the gingerols turn into shogaols, which have similar or higher activity. Ginger has GRAS status and is used in meat products mostly as powder, at 0.5–2%.

The objectives of the experimental part were: (i) to obtain two samples of cooked pork offal sausage (caltaboș), a control and a sample with 1% ginger; (ii) to characterize both samples from a sensory and physico-chemical point of view; (iii) to compare their oxidative stability, pH and instrumental color during refrigerated storage.

Material and method

Caltaboș was made from pork head meat, firm back fat, pork offal, rind, ears, liver and diaphragm, with hydrated rice and broth from boiling the pork head. Onion, salt, pepper and dried ginger powder were the seasonings, and natural pork casings were used for stuffing. Two samples were produced with the same recipe and technology: a control (CS) and a sample with 1% ginger powder relative to the total mass of the composition (GS).

The cooked components were cooled to 50–60 °C before mincing, and the sausages were cooked until the core reached at least 70 °C. Both samples were stored at 2–4 °C for 7 days. The processing steps are shown in Figure 1.



[1] *pork head meat, firm back fat, pork offal, rind and ears, liver, diaphragm*

Figure 1. Technological flow for obtaining cooked pork offal sausage with ginger

Analytical methods

Physico-chemical analysis was performed according to the following methods: moisture (ISO 1442:1997); fat (SR ISO 1444:2008, Soxhlet); protein (SR ISO 937:2007); NaCl (Mohr method, STAS 9065/5-1973); fat freshness (Kreiss reaction, STAS 9065/10-75); carbohydrates and energy value calculated according to Regulation (EU) No 1169/2011.

Lipid oxidation was measured with the thiobarbituric acid (TBA) test (Specord 210 spectrophotometer), pH according to SR EN ISO 2917:2003 (WTW pH 3110) and color in the CIE L*a*b* system according to SR EN ISO 11037:2013 (Konica Minolta CR-400, D65, 10°), on days 1, 3 and 7 of storage. The total color change relative to day 1 was $\Delta E^* = \sqrt{[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]}$. Eight trained assessors scored the samples on a 10-point hedonic scale.

Acknowledgement: The authors of this research express their gratitude for the support University of Life Sciences “King Michael I”, Timisoara.

Results and discussions

Proximate composition

Table 1. Physico-chemical composition of the sausage with ginger

Sample	Physico-chemical parameters						
	Moisture (g/100 g)	Protein (g/100 g)	Fat (g/100 g)	NaCl (g/100 g)	Ash (g/100 g)	Carbo-hydrates (g/100 g)	Energy value (kcal/100 g)
GS	58.43	17.92	21.15	2.76	0.71	0.63	256.84
MLA	≤ 72	≥ 8	≤ 27	≤ 3	–	–	–

GS – cooked pork offal sausage with 1% ginger; MLA – maximum/minimum limit accepted by Order No. 210/2006

All regulated parameters of GS were within the limits of Order No. 210/2006 for cooked meat products. The Kreiss reaction was negative, so the fat was fresh, and 100 g of product covers 12.84% of the reference energy intake.

Oxidative stability, pH and color during storage

TBA values rose in both samples but stayed lower in GS, by 35.8% on day 3 and 32.5% on day 7. pH fell by 0.10 units in GS and by 0.21 units in CS, within the normal range for cooked meat products (6.2–6.8). L* dropped by 3.28 units with ginger and by 6.18 units without it. The control passed the visible-difference threshold (ΔE* > 3.5) by day 3, while GS stayed below it until day 7, when its ΔE* was 43.3% lower than in CS.

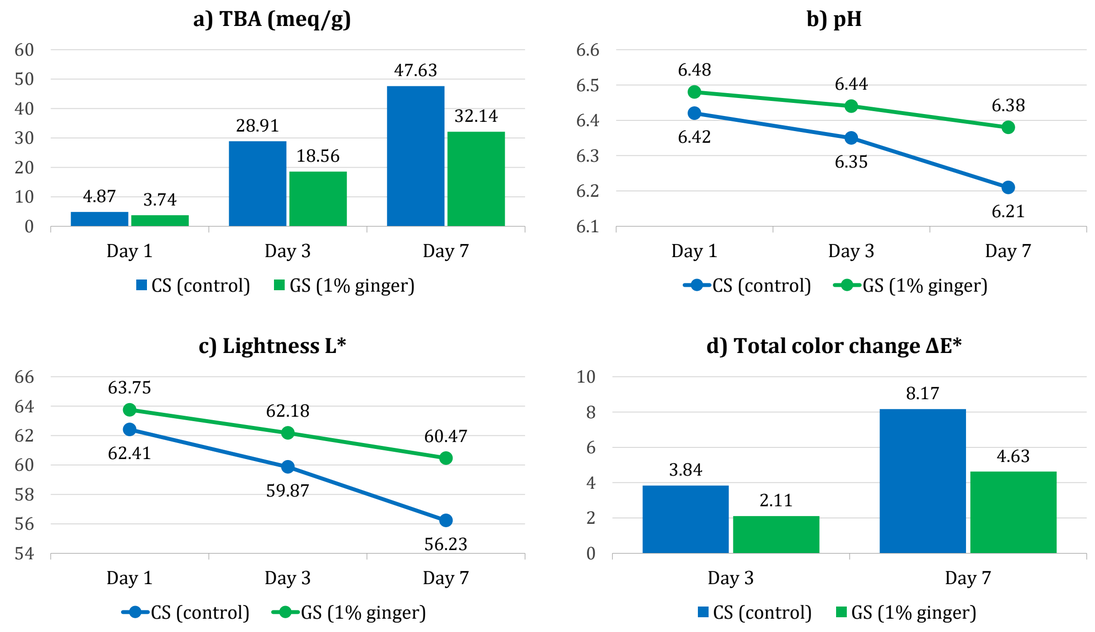
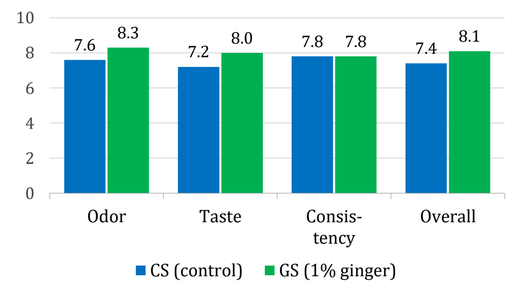


Figure 2. Changes in the samples during refrigerated storage at 2–4 °C (ΔE* relative to day 1)

Sensory evaluation

The panel preferred GS for odor, taste and overall acceptability, while consistency scored the same (7.8). Ginger gave a slightly warmer, golden hue, fine yellowish specks on the cross-section and a warm, slightly pungent note. Seven of the eight assessors found the pungency pleasant; one found it slightly strong at 1%, so 0.7–0.8% is worth testing.

Figure 3. Sensory scores (1–10)



Conclusions

Cooked pork offal sausage with 1% dried ginger powder met the physico-chemical limits of Order No. 210/2006, and its Kreiss reaction was negative. During 7 days at 2–4 °C, ginger lowered TBA values by 32.5–35.8% (days 3 and 7), halved the pH drop (0.10 vs. 0.21 units) and reduced the total color change by 43.3% (ΔE* 4.63 vs. 8.17). The panel rated the ginger sample higher for odor, taste and overall acceptability (8.1 vs. 7.4). These results support the use of ginger powder as a natural antioxidant in cooked meat products; lower levels (0.7–0.8%) should be tested to soften the pungency.