THE EVALUATION OF THE IMPACT OF SOYBEAN SPROUTS ON THE LIPID OXIDATION AND ORGANOLEPTIC QUALITY OF CHICKEN PATTIES

Alamuoye N. O[1]* and Alamuoye O. F[2].
[1]Food Science and Technology Department, School of Agriculture and Agricultural Technology, Bamidele Olumilua University of Education Science and Technology, Ikere Ekiti, Nigeria
[2]Animal Science Department, Faculty of Agricultural Science, Ekiti State University, Ado Ekiti, Nigeria.
*Corresponding Author: alamuoye.nathaniel@yahoo.com; alamuoye.nathaniel@bouesti.edu.ng

ABSTRACT
The study assessed the effect of soybean sprouts on the lipid oxidation and sensory quality of chicken patties. Lipid oxidation and organoleptic quality were evaluated via thiobarbituric acid reactive substances (TBARS) assay which measured malondialdehyde (MDA) levels as a marker of lipid oxidation on a 9-point hedonic scale, respectively. The results showed that the lipid oxidation was found with chicken patties that had the highest composition of soybean sprout inclusion which ranged from 0.12 to 0.15. The sensory attributes of the patties experienced enhancement with the inclusion of soybean sprouts. The outcomes of this investigation showed that the integration of soybean sprouts into chicken patties exhibits a notable impact on lipid oxidation alongside the general quality of the product.
Keywords: Flavour, Additive, Incorporation, Quality, Sprout

INTRODUCTION

Chicken meat, patties included is a common food product vulnerable to lipid oxidation, which can negatively impact their flavor, texture, and shelf life (Hearn et al., 2021). Similarly, soybean sprouts have gained popularity in recent years due to their potential health benefits and versatility in cooking as they are very rich in essential nutrients such as protein, vitamin C, and isoflavones (Huang et al., 2022; Rao et al., 2022; Ha et al., 2022). The high content of antioxidants and phytochemicals in soybean sprouts has been linked to their ability to inhibit lipid oxidation, a key process leading to the deterioration of food quality (Tang et al., 2021; Wang et al., 2022)
The incorporation of soybean sprouts in food products has gained attention due to their potential health benefits and ability to enhance food quality of both nutritional value and sensory attributes. Isoflavones in soybean sprouts have been associated with numerous health benefits, such as potential alternative therapies for hormone-dependent conditions like menopausal symptoms, cancer, cardiovascular disease, and osteoporosis (Wang et al., 2022). Bioactive peptides derived from soybeans have been shown to have cholesterol-lowering effects, enhance immunity, and promote calcium absorption (Kim et al., 2021).

Lipid oxidation has been denoted a major determinant of quality in meat products (Wazir et al., 2021; Wu et al., 2022; Bak et al., 2023), as it leads to off-flavors, contributing to the formation of volatile compounds that influence taste and aroma, colour changes, and decreased shelf life (Jurčaga et al., 2021, Fu et al., 2022). By investigating the impact of soybean sprouts on lipid oxidation in chicken patties, we can further optimize the formulation of this widely consumed food item to offer consumers a healthier and more stable product.
When considering chicken patties, their interaction with moisture becomes particularly relevant due to the potential impact on lipid oxidation and overall product quality. As researchers continue to explore the relationship between soybean sprouts and lipid oxidation in food products, there remains a significant gap in our understanding of how this interaction may influence the quality of chicken patties. There is a lack of comprehensive studies that specifically examine the effects of incorporating soybean sprouts into chicken patties on lipid oxidation and overall product quality. By addressing this research gap, we can gain valuable insights into how soybean sprouts may impact the oxidative stability of lipids in chicken patties, as well as potential changes in sensory attributes such as taste, texture, and colour. This study aims to fill this gap by investigating the effect of soybean sprouts on lipid oxidation and the quality of chicken patties, providing valuable information for both the food industry and consumers. Therefore, the study investigated the impact of soybean sprouts on the oxidative stability of lipids in chicken patties and changes in the sensory.

MATERIALS AND METHODS

Preparation of Soybean Sprout

High-quality soybean seeds were selected to ensure they are viable and free from damage. The seeds were properly cleaned and soaked in clean water for 24 hours to allow for adequate hydration and initiation of the sprouting process. A suitable sprouting tray underlay with wet cotton wool was used to facilitate optimal conditions for germination and growth. Regular wetting and draining of the seeds were done to prevent mold or bacterial growth. Adequate air circulation was ensured to achieve healthy sprout development in 10 days. Sprouted seeds were

collected, oven-dried at 60^0 C, and milled into powder. The milled soybean sprout was stored in the polythene bag prior to use at room temperature.

Preparation of chicken patties

1 kg of ground chicken breast muscle was placed in a food processor. All non-meat ingredients (Table 1) were added and finely ground into a homogenized mixture. The mixture of ground chicken breast muscle and non-meat ingredients was portioned into 5 parts, each portion constituting a treatment group for the experiment. Different levels of additive of sprout soy-bean powder that comprise 0%, 5%, 10%, 15% and 20% were incorporated into 5 portion treatment groups respectively. The raw patties were shaped into flat sheets to ensure that they cook uniformly and have an appealing presentation. Prior to cooking, it was refrigerated for 30 minutes to allow them to firm up and prevent them from falling apart during the cooking process. To achieve a crispy exterior, the patties were pan-fried in a bit of oil over medium-high heat. The patties were flipped once they were golden brown on one side. This procedure was repeated four more times to produce enough replicate for the experiment.

Table 1: Non-meat ingredient composition

Composition of non-meat ingredients include 1% salt, 5% chilli pepper, 2% onion powder, 9% garlic paste, 2% coriander, 1% thyme, 1% curry, 5% paprika, 4% monosodium glutamate, 60% bread crumbs and 10% raw egg.

Lipid oxidation

The TBARS procedure, as put forth by Buege and Aust (1978), was employed for the quantification of lipid peroxidation. The primary reaction integral to this method hinges on malondialdehyde (MDA), a principal resultant of lipid peroxidation, interacting with thiobarbituric acid (TBA) to generate a pink chromogen. The quantification of which was performed via spectrophotometric analysis. The calculation employed in this technique entailed the determination of the TBARS value, frequently denoted as MDA equivalents, by evaluating the absorbance of the pink chromogen at a designated wavelength of 532 Nm. To compute TBARS, the formula necessitates the multiplication of the absorbance of the sample at a wavelength of 532 nm by a predetermined multiplier (1.56×10^5). This factor serves to amend background noise and transmutes the results into MDA equivalents. Such calculations afford the capacity to furnish precise measurements of lipid peroxidation levels within the sample. 0.6 mL of the sample extract was added to a test containing 3 mL each of I % TBA solution and glacial acetic acid. This mixture was thoroughly mixed and placed in a boiling water bath for 15 min. The absorbance of the supernatant after centrifugation was measured. The supernatant from the blank was used to adjust the spectrophotometer to zero. Distilled water was used to replace the sample extract to make up for the blank solution. The experiment was repeated to obtain three replicates.

$$TBA = \frac{ODxV1x1000}{AxV2xLxG}$$

Where: O.D = Optical Density at 532 Nm; V1 = 6.6 mL; A = Multiplier = 1.56×10^5; L = Length of light path = 1 cm; G = Sample milligram

V2= Used extract volume = 0.6 Ml

Sensory evaluation

The Hedonic Scale, which gauges the extent of liking or disliking for a product on a numeric scale spanning from 1 to 9 was used. This metric facilitates the quantification of subjective sensory experiences. The initial phase involved selection alongside rigorous training of a panel encompassing expert evaluators, who possess acute understanding concerning sensory attributes. These evaluators endured rigorous training sessions aimed at calibrating their sensory perceptions, thereby ensuring consistency within their judgment. Individual evaluators received samples of the chicken patties and were solicited to rate said samples on a Hedonic Scale, span ranging from "dislike extremely" to "like extremely" (AMSA, 1995).

Data analysis

The executed research made use of IBM SPSS Statistics 20 for purposes of conducting statistical analysis, with a particular employment of One-way ANOVA Post Hoc Multiple Comparisons utilizing the Student-Newman-Keuls test at a significance demarcation of 0.05 (SPSS, 2011).

RESULTS AND DISCUSSION

The investigatory output of lipid oxidation suggests that there exists a notable variability in lipid oxidation levels of chicken patties in relation with soybean sprout formulation percentage employed in the chicken patty formulation (Table 4). As evidenced, chicken patties with elevated percentages of soybean sprouts portrayed comparatively diminished lipid oxidation levels relative to those either with reduced concentrations or devoid of soybean sprouts. These deductions intimate that incorporating soybean sprouts within chicken patty formulations might offer a defensive mechanism against lipid oxidation, potentially attributable to antioxidant characteristics

deriving from the bioactive components inherent in soybean sprouts ((Mamilla and Mishra, 2017; Kim and Kim, 2020; Mastropasqua, 2020). Such exploration affords pivotal cogitation regarding soybean sprouts' prospective efficacy as a natural antioxidant within meat products, underlining the imperative to contemplate plant-derived ingredients in meat formulation aimed at bolstering product integrity and prolonging shelf life. Comprehending the effects exerted by soybean sprout extract on lipid oxidation in chicken patties is indispensable for the food industry; as it delivers critical perspectives on feasible natural methods for meat product preservation devoid of diminishing their sensory characteristics.

Table 2: Oxidative stability of cooked chicken patties

Days	Thiobarbituric Acid-Reactive Substance (TBARS) Mean±SD				
	CP without SSA	CP with 5% SSA	CP with 10% SSA	CP with 15% SSA	CP with 20% SSA
1	0.45±0.01^{d}	0.32±0.01^{c}	0.28±0.00^{b}	0.13±0.01^{a}	0.12±0.01^{a}
14	0.47±0.02^{d}	0.35±0.02^{c}	0.29±0.01^{b}	0.13±0.01^{a}	0.12±0.01^{a}
21	0.56±0.02^{e}	0.41±0.01^{d}	0.32±0.01^{c}	0.17±0.01^{b}	0.14±0.00^{a}
28	0.62±0.02^{e}	0.42±0.01^{d}	0.36±0.02^{c}	0.19±0.01^{b}	0.15±0.01^{a}

SD- Standard deviation. CP- Chicken Patties, SSA- Soybean Sprout Additive. Significantly differ at $p<0.05$ in the column, means carrying distinct superscripts within

However, the investigation outcomes concerning the organoleptic attributes of chicken patties incorporating variant soybean sprout compositions divulged multiple pivotal observations (Table 5). Pertaining to gustatory aspects, patties incorporating an elevated proportion of soybean sprouts were systematically adjudicated to possess a more intense and savoury flavour. Correspondingly, the texture attributes of the patties experienced enhancement with the inclusion of soybean sprouts, attributing a moist and tender consistency which garnered preference among participants. Nevertheless, it was observed that excess incorporation of soybean sprouts detrimentally influenced the patties' overall quality, with some participants deeming them excessively mushy or overwhelmingly flavoured. Such findings underscore the necessity of meticulously calibrating the inclusion of soybean sprouts in chicken patties to optimize their organoleptic characteristics and secure consumer gratification. The scrutinized influence of soybean sprouts on the organoleptic quality of chicken patties, furnished essential insights for the food sector in formulating healthier and more delectable meat commodities that align with consumer inclinations and dietary requisites.

Table 3. Sensory properties of cooked chicken patties

Products	Organoleptic properties (Mean±SD)					
	Flavour	Aroma	Juiciness	Texture	Tenderness	Overall acceptability
CP without SSA	6.12±0.01^{a}	5.85±0.06^{a}	5.67±0.12^{d}	5.43±0.12^{a}	5.73±0.15^{e}	6.53±0.02^{b}
CP with 5% SSA	6.53±0.01^{b}	6.22±0.13^{b}	6.41±0.13^{c}	5.72±0.01^{b}	5.94±0.05^{d}	7.28±0.06^{c}
CP with 10% SSA	7.14±0.08^{c}	6.32±0.26^{b}	6.52±0.13^{c}	5.81±0.12^{b}	6.45±0.06^{c}	7.49±0.12^{d}
CP with 15% SSA	7.64±0.08^{d}	7.76±0.12^{c}	7.72±0.07^{b}	6.26±0.16^{c}	7.20±0.06^{b}	6.51±0.13^{b}
CP with 20% SSA	8.20±0.13^{e}	7.84±0.09^{c}	8.23±0.06^{a}	7.57±0.07^{d}	8.11±0.13^{a}	5.61±0.41^{a}

SD- Standard Deviation, CP- Chicken Patties, SSA- Soybean Sprout Additive. Significantly differ at $p<0.05$ in the column, means carrying distinct superscript within

CONCLUSION

The outcomes of this investigation yielded insights into the sorption traits of chicken patties. The sorption isotherms revealed that the patties experienced continuous absorption at increasing relative humidity. Such information bears importance for decoding the potential shelf life and quality of chicken patties during their storage phase. Also, chicken patties enriched with elevated amounts of soybean sprout extract manifested diminished rates of lipid oxidation in contrast to those embedded with reduced compositions. This infers that soybean sprout possesses the capacity to efficaciously curb lipid oxidation within chicken patties, possibly prolonging product shelf life and elevating overall quality. Finally, the outcomes of sensory evaluation evinced that patties with escalated soybean sprout contents exhibit more coveted gustation, olfaction, and tactility in contrast to those with diminished contents or devoid of such additives. This implies that soybean sprouts augment not solely the nutritive value but also ameliorate the sensory characteristics of the patties.

REFERENCES

AMSA. (1995). Research Guidelines for Cookery, Sensory evaluation and Instrumental measurement of fresh meat. National Livestock and Meat Board, Chicago, IL, USA. Retrieved from http://www.meat science.org

Bak, K., Bauer, S., & Bauer, F. (2023). Effect of Different Genotypes and Harvest Times of Sage (Salvia spp. Labiatae) on Lipid Oxidation of Cooked Meat. *Antioxidants*, *12*(3), 616. https://doi.org/10.3390/antiox12030616.

Fu, Y., Cao, S., Yang, L., & Li, Z. (2022). Flavor formation based on lipid in meat and meat products: A review. *Journal of food biochemistry*, e14439. https://doi.org/10.1111/jfbc.14439.

Buege, J.A. and S.D. Aust, 1978. Microsomal Lipid, Peroxidation. In: Methods in Enzymology, Vol. 52, Flesicher, S. and L. Packer (Eds.)., Academic Press, New York, pp: 302-310.

Hearn, K., Denzer, M., Mitacek, R., Maheswarappa, N. B., McDaniel, C., Jadeja, R., Mafi, G., Beker, A., Pezeshki, A. & Ramanathan, R., (2021) "Effects of Modified Atmospheric Packaging on Ground Chicken Colour and Lipid Oxidation", *Meat and Muscle Biology* 5(1), 36, 1 – 9. doi: https://doi.org/10.22175/mmb.12599

Huang, Y., Lei, N., Xiong, Y., Liu, Y., Tong, L., Wang, F., Fan, B., Maesen, P., & Blecker, C. (2022). Influence of Selenium Biofortification of Soybeans on Speciation and Transformation during Seed Germination and Sprouts Quality. *Foods*, 11. https://doi.org/10.3390/foods11091200.

IBM SPSS Statistics 20, 2011.

Kim, M., & Kim, M. (2020). Isoflavone profiles and antioxidant properties in different parts of soybean sprout. *Journal of food science*. 85(3): 689-695. https://doi.org/10.1111/1750-3841.15058.

Kim, I., Yang, W., & Kim, C. (2021). Beneficial Effects of Soybean-Derived Bioactive Peptides. *International Journal of Molecular Sciences*. *22*(16), 8570. https://doi.org/10.3390/ijms22168570.

Wang, S., Zhang, Y., Zhu, G., Shi, X., Chen, X., Herrera-Balandrano, D., Liu, F., & Laborda, P. (2022). Occurrence of isoflavones in soybean sprouts and strategies to enhance their content: A review. *Journal of food science*. 87(5): 1961-1982. https://doi.org/10.1111/1750-3841.16131.