DR-1844
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RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume Issue : ()

Evaluation of Essential Oils as a Hurdle for Ambient Temperature Storage of Chicken Patties

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10.18805/ajdfr.DR-1844

ABSTRACT

Background: Clove bud oil (CBO) and oleoresin rosemary (ORM) possess antioxidant and antibacterial properties and are widely used as natural preservatives in meat products. The present study was conducted with the objective of evaluating the essential oils CBO and ORM as a hurdle for extending the shelf life of chicken patties at ambient temperature storage.

Methods: The natural preservatives *viz*. CBO at 0.05% level (T_1) and ORM at 0.1% level (T_2) and their combination (CBO 0.05% with ORM 0.1%) (T_3) were incorporated in chicken meat patties in the basic formulation along with a control (C) and the cooked product quality packed in food grade pet-poly co-extruded film pouches stored at ambient temperature (30±2°C) was assessed.

Result: Upon storage, in terms of sensory evaluation, T_3 spoiled on 5th day and other samples on 3rd day of storage. Addition of essential oils significantly (P<0.05) enhanced the DPPH scavenging effect. TBARS and tyrosine values of all treatments significantly (P<0.05) increased linearly with storage period. CBO and ORM combination significantly (P<0.05) inhibited the microbial load during the storage period and maintained the odour score in the acceptable level even at 3rd day of storage. The combination of CBO and ORM might be applied as one of the hurdles in adopting the 'Hurdle Technology' storage of chicken meat patties.

Key words: Clove bud oil, Chicken patties, Oleoresin rosemary, Shelf-life extension.

INTRODUCTION

The speciality of the Indian foods lies in the array of spices used in the cuisine varieties, especially in the meat dishes. The essential oils containing the unique aromatic compounds are derived from the spices by various extraction methods. These essential oils find their place in many food preparations and pharmaceutical products. Nychas (1995) reported antimicrobial activity of essential oils from oregano, thyme, sage, rosemary, clove, coriander, garlic and onion against both bacteria and molds. Hurdle technology, which involves simultaneous multiple preservation approaches, has generally met with success in controlling pathogens and maintaining food quality during storage (Leistner, 2000). Hence the essential oils might serve as one of the hurdles in meat and meat products preservation.

The antimicrobial and antioxidant properties of clove bud oil and oleoresin rosemary had been established earlier and their use in various including meat products foods had been vividly studied. Clove essential oil based coatings were found to be effective in inhibition of microbial growth in stored raw chicken meat (Mukhtar *et al*., 2018) maintaining the sensory quality of meat and meat products and in beef sucuks (Saricaoglu and Turhan, 2019) improving its physical, chemical and microbiological properties. It was recommended that rosemary essential oil (350 ppm) could be an excellent natural antioxidant substitution or partial replacement to the synthetic antioxidants used currently in meat preservation (Al-Hijazeen and Al-Rawashdeh, 2019).

This study was conducted with the objective of evaluating the clove bud oil (CBO), oleoresin rosemary (ORM) and their combination in chicken meat patties as a hurdle with "Natural tag" for storage of chicken meat patties at ambient temperature (30±2°C).

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How to cite this article: Kalaikannan, A., Elango, A., Rajeshwar, J.J. and Santhi, D. (2022). Evaluation of Essential Oils as a Hurdle for Ambient Temperature Storage of Chicken Patties. Asian Journal of Dairy and Food Research. DOI: 10.18805/ajdfr.DR-1844.

Submitted: 23-11-2021 **Accepted:** 06-04-2022 **Online:** 09-05-2022

MATERIALS AND METHODS

Experimental design

Based on the available literature, clove bud oil (CBO), oleoresin rosemary (ORM) and their combination in chicken meat patties were added as natural preservatives. Based on the preliminary trials, CBO 0.05% (T_1), ORM 0.1% (T_2) and their combination (CBO 0.05% with ORM 0.1%) (T_3)

were added to the chicken patties in the basic formulation as three treatments along with a control (C). The physico-chemical, microbiological and sensory attributes of fresh product and those stored at ambient temperature on 1st, 3rd and 5th days of storage were assessed. Upon storage at ambient storage except T_3 all others spoiled on 3rd day and T_3 spoiled on 5th of ambient temperature storage. The spoiled patties were not evaluated for any parameter.

Source of raw materials

Broiler meat

Dressed broiler carcasses were purchased from the retail outlets of Namakkal town, packed in virgin polyethylene bags and transported in thermo cool box to the Department of Livestock Products Technology (Meat Science), Veterinary College and Research Institute. The carcasses were hygienically deboned and trimmed of all visible adipose and connective tissues at the department processing facility. The deboned meat was minced through an 8-mm plate using a MADO junior meat mincer and stored at -18±2°C in low-density polyethylene (LDPE) packs as 500 g packs until further use.

Essential oils

Certified food grade essential oils were purchased from M/S Akay Flavour and Aromatics Pvt Limited, Kochi.

Preparation of chicken meat patties

The frozen minced meat was tempered to 4°C by keeping in refrigerator overnight for the preparation of emulsion. The emulsion was prepared by adding minced meat and the other ingredients of the formulation (Table 1) in a sequential order at a specified time interval. During chopping, the temperature of the emulsion was maintained at 10-12°C by the addition of slushed ice. Patties were formed by weighing 50 g of meat emulsion and formed into patties using stainless mould and placed on the vegetable oil smeared stainless steel cooking trays. The patties were cooked in preheated hot air oven at 180°C for 25 minutes. After 15 minutes of heating the patties were turned upside down and cooked for another 10 minutes so as to attain the internal temperature of 82±1°C as measured by probe thermometer. After attaining the core temperature, the patties were maintained at 100°C for additional 10 minutes to reduce the water activity (a_w). Then the patties were cooled to room temperature, packed in food grade pet-poly co-extruded film pouches (one patty in a pouch) and stored at the room temperature for carrying out the physico-chemical, microbiological and sensory evaluation on the 0 day, 1st day and the 3rd day.

Table 1: Formulation of chicken meat patties.

Ingredients	Amount (g)
Lean meat	1000
Vegetable oil (sunflower oil)	50
Salt	20
Ginger	25
Garlic	25
Onion	25
Spice mix	25
Maida	30
Slushed ice	50

Analytical procedures

The patties were analysed for physico-chemical parameters such as product pH (digital pH meter Model 361, Systronics, India), water activity (with Paw kit water activity meter, Decagon, Devices, USA), free fatty acids (by using modified method of AOAC, 1975), DPPH [(2,2' diphenylpicrylhydrazyl) assay (Wu *et al*., 2003)], tyrosine value (Strange *et al.,* 1977) and TBARS (Thiobarbituric acid reactive substances) number (Tarladgis *et al.,* 1960) for storage studies. The patties were subjected to sensory quality evaluation on alternate days at ambient temperature (Appearance and odour score). Semi trained sensory panel consisting of students and teaching faculty of the college evaluated the products. Samples were evaluated for appearance, flavour, texture, juiciness, spiciness and overall palatability using an 8- point hedonic scales (Keeton, 1983). Total viable count, staphylococcal, psychrophilic, as well as yeast and mold counts were determined following the procedure described by ICMSF (1978) for the chicken meat patties.

Statistical Analysis

The data generated in the present study were subjected to statistical analysis (Snedecor and Cochran, 1995) for analysis of variance, critical difference and Duncan's multiple range test was done for comparing the means to find the effect of treatment, storage period and their interaction. A total number of six observations (n=6) were analysed for each experiment.

RESULTS AND DISCUSSION

Physico-chemical parameters

Product pH, water activity (a_w) and free fatty acid content of the product increased linearly over the storage period (Table 2) which was in accordance with Babu *et al*. (2012) and Sharma *et al.* (2020) who studied the refrigerated storage of chicken patties incorporated with essential oils. Similar increase in a_w was noticed during storage of caprine kheema (Karthikeyan *et al*., 2000) and minced poultry meat (Jaworska *et al*., 2021). The increment in FFA values was in accordance with Modi *et al*. (2009). Further, he attributed the increment in FFA is due to the lipase activity in food matrix.

DPPH scavenging activity of rosemary added patties was highest, which was in accordance with Mielnik *et al*., (2008), but its reducing power was lower in combination. Incorporation of essential oil blends in chicken sausages significantly increased the DPPH scavenging activity upon the refrigerated storage (4±1°C) (Sharma *et al*., 2020). Carnosol and carnosic acid have been suggested to account for over 90% of the antioxidant properties of rosemary extract (Aruoma et al, 1992). In assessing the antioxidant capacity of carnosic acid (CA) extracted from dried rosemary leaves

Table 2: Effect of clove bud oil, oleoresin rosemary and their combination on physico-chemical characteristics of chicken meat patties stored at ambient temperature (30±2°C).

Parameters	Treatments	Storage days			Overall Treatment
		0	1	3	Mean±SE
Product pH	C	6.26±0.05	6.34±0.04	spoiled	6.30±0.03
	T_1	6.29±0.03	6.33±0.04	spoiled	6.31±0.03
	T_2	6.29±0.01	6.35±0.00	spoiled	6.32±0.01
	T_3	6.25±0.03	6.34±0.03	6.55±0.03	6.38±0.05
	Days Mean±SE**	6.27±0.01^b	6.34±0.01^b	6.55±0.02^a	
Water activity (a_w)	C	0.92±0.01	0.93±0.00	spoiled	0.923±0.003
	T_1	0.93±0.00	0.93±0.00	spoiled	0.930±0.003
	T_2	0.93±0.01	0.93±0.00	spoiled	0.932±0.003
	T_3	0.93±0.01	0.94±0.01	0.94±0.00	0.936±0.004
	Days Mean±SE**	0.926±0.002^b	0.933±0.002^{ab}	0.943±0.003^a	
Free fatty acids (%)	C	0.19±0.01	0.28±0.01	spoiled	0.24±0.02
	T_1	0.19±0.00	0.26±0.01	spoiled	0.22±0.02
	T_2	0.19±0.00	0.24±0.01	spoiled	0.22±0.01
	T_3	0.19±0.00	0.23±0.00	0.25±0.01	0.23±0.01
	Days Mean±SE**	0.19±0.00^b	0.25±0.01^a	0.25±0.01^a	
DPPH scavenging activity (%)	C	16.59±0.43	14.72±0.85	spoiled	15.65±0.60^b
	T_1	25.36±5.30	23.95±0.67	spoiled	24.66±2.41^a
	T_2	31.15±6.23	28.64±0.68	spoiled	29.90±2.85^a
	T_3	28.40±6.43	27.37±1.12	25.87±0.97	27.21±1.94^a
	Days Mean±SE	25.37±2.76	23.67±1.68	25.87±0.96	**
TBARS (mg malonaldehyde/ 100 g)	C	0.50±0.03	1.00±0.09	spoiled	0.75±0.12
	T_1	0.43±0.04	0.74±0.06	spoiled	0.59±0.08
	T_2	0.43±0.01	0.56±0.01	spoiled	0.50±0.03
	T_3	0.47±0.03	0.58±0.03	1.12±0.21	0.72±0.12
	Days Mean±SE**	0.46±0.02^c	0.72±0.06^b	1.12±0.21^a	
Tyrosine value (mg/100 g)	C	10.26±0.97	25.16±2.95	spoiled	17.71±3.61
	T_1	12.73±0.45	24.02±2.53	spoiled	18.37±2.77
	T_2	9.85±0.87	22.48±1.76	spoiled	16.16±2.96
	T_3	10.08±0.50	21.21±1.19	27.46±1.31	19.59±2.60
	Days Mean±SE**	10.73±0.47^c	23.22±1.05^b	27.46±1.31^a	

Treatments: C- Control, T_1- Clove bud oil 0.05%, T_2 - Oleoresin rosemary 0.1% and T_3 - Clove bud oil 0.05% + Oleoresin rosemary 0.1%
Means bearing different superscripts column-wise and row-wise differ significantly.
**-Highly significant (P≤0.01).
Means without super script are not significantly different.

in raw and cooked ground buffalo meat patties and chicken patties, Naveena *et al*. (2013) found that CA at 22.5 ppm or 130 ppm reduced the lipid oxidation in cooked patties.

TBARS values of all the patties increased linearly with storage period similar to the results of Sureshkumar *et al*. (2010). The tyrosine value of the chicken meat patties linearly increased (P<0.05) with increase in storage period similar to the results of Michalczyk *et al*. (2012) in ground beef added with coriander essential oil. The addition of essential oils significantly reduced the increment of tyrosine value in the control and treatments.

Microbiological quality parameters

Total viable count of chicken meat patties significantly (P<0.05) increased with the increase in storage period (Table 3) in accordance with the results of Thomas *et al*., (2008). A study by Vergara *et al*. (2021) using different rosemary formats to extend the shelf-life of vacuum-packed lamb meat raw burgers showed that none of the forms of rosemary studied were able to inhibit the TVC count, an indicator of the deterioration of the meat. On the 1st day microbial analysis, staphylococcal count was least in the clove oil added patties. Similarly, Thomas *et al*. (2008) observed no growth in the hurdle treated pork sausages upto 5 days of ambient temperature storage. Addition of clove oil reduced staphylococcal count in the chicken patties. The antimicrobial activity of clove essential oil is mainly due to its bioactive compound of eugenol (Qin *et al*., 2017; Xu *et al*., 2019), which was detected as 17.02% oil by Sarýcaoglu and Turhan (2020). Addition of essential oils slightly decreased the yeast and mould count over the control; however, the results were not significant.

Sensory parameters

The appearance and odour scores of the chicken meat patties significantly (P<0.05) decreased with the increase in storage days (Table 4) as observed by Kalaikannan *et al*. (2007) and Sureshkumar *et al*. (2010). Naveena *et al*. (2006) reported that the addition of clove oil improved colour scores of carabeef during the retail display period. Addition of the clove oil and rosemary in combination maintained the odour score in the acceptable level even at 3rd day of storage. Ibrahim *et al*. (2018) observed that the overall acceptability of chicken fillets added with 0.1% rosemary essential oil was significantly higher than that of the control, during

Table 3: Effect of clove bud oil, oleoresin rosemary and their combination microbiological quality of chicken meat patties stored at ambient temperature (30±2°C).

Parameters (log cfu/g)	Treatments	Storage days			Overall treatment
		0	1	3	Mean±SE
Total viable count	C	3.29±0.41	3.90±0.20	spoiled	3.59±0.25
	T_1	3.13±0.27	3.72±0.05	spoiled	3.42±0.18
	T_2	2.32±0.01	3.86±0.18	spoiled	3.09±0.35
	T_3	3.25±0.40	3.72±0.06	5.06±0.24	4.01±0.30
	Days Mean±SE**	3.00±0.18^c	3.80±0.06^b	5.06±0.24^a	
Staphylococcal count	C	ND	1.59±0.06	spoiled	1.59±0.06
	T_1	ND	1.39±0.07	spoiled	1.39±0.09
	T_2	ND	1.49±0.12	spoiled	1.49±0.12
	T_3	ND	1.45±0.12	2.24±0.23	1.92±0.24
	Days Mean±SE**	ND	1.49±0.05	2.24±0.23	
Psychrophilic count	C	2.03±0.38	2.06±0.38	spoiled	2.05±0.24
	T_1	1.97±0.16	2.07±0.06	spoiled	2.02±0.08
	T_2	2.09±0.23	2.01±0.12	spoiled	2.05±0.12
	T_3	1.85±0.37	2.13±0.22	2.26±0.09	2.08±0.14
	Days Mean±SE	1.99±0.13	2.07±0.10	2.26±0.09	
Yeast and Mould count	C	2.20±0.21	2.43±0.19	spoiled	2.31±0.14
	T_1	1.98±0.16	2.24±0.31	spoiled	2.11±0.17
	T_2	2.00±0.35	2.41±0.24	spoiled	2.21±0.21
	T_3	2.13±0.42	2.27±0.34	3.79±0.07	2.73±0.31

Treatments: C- Control, T_1- Clove bud oil 0.05%, T_2 - Oleoresin rosemary 0.1% and T_3 - Clove bud oil 0.05% + Oleoresin rosemary 0.1%
Means bearing different superscripts column-wise and row-wise differ significantly.
** - Highly significant (P≤0.01).
Means without super script are not significantly different.

Table 4: Effect of clove bud oil, oleoresin rosemary and their combination on sensory characteristics of chicken meat patties stored at ambient temperature (30±2°C).

Parameters	Treatments	Storage days			Treatment
		0	1	3	Mean±SE
Appearance score	C	6.92±0.19	6.50±0.19	5.33±0.14	6.25±0.15
	T_1	7.00±0.12	6.67±0.14	5.58±0.15	6.42±0.13
	T_2	6.75±0.13	6.58±0.15	5.50±0.15	6.28±0.12
	T_3	6.83±0.11	6.75±0.13	6.08±0.15	6.56±0.09
	Days Mean±SE**	6.88±0.07^a	6.63±0.08^b	5.63±0.08^c	**
Odour score	C	7.25±0.13	6.58±0.19	1.00±0.00	4.94±0.48^b
	T_1	7.17±0.17	6.67±0.19	1.00±0.00	4.94±0.48^b
	T_2	7.33±0.14	6.75±0.18	1.00±0.00	5.03±0.49^b
	T_3	7.33±0.14	6.83±0.17	5.83±0.11	6.67±0.13^a
	Days Mean±SE**	7.27±0.07^a	6.71±0.09^b	2.21±0.31^c	

Treatments: C- Control, T_1- Clove bud oil 0.05%, T_2 - Oleoresin rosemary 0.1% and T_3 - Clove bud oil 0.05% + Oleoresin rosemary 0.1%
Means bearing different superscripts column-wise and row-wise differ significantly.
** - Highly significant (P≤0.01).
NS - Not Significant.

refrigerated storage and the level of ORM used is in accordance with the present study.

CONCLUSION

The study reveals the antioxidant potential of the clove bud oil and oleoresin rosemary incorporated in chicken meat patties where the shelf-life was extended up to one day in ambient temperature. The use of essential oils is one of the remarkable approaches to be used as one of the hurdles in the preservation of meat products. It is observed from this study that clove bud oil at 0.05% and oleoresin rosemary at 0.1% could be used in chicken meat patties without affecting the sensory properties. Further attempts incorporating additional hurdles would pave way for further extending the shelf-life of chicken meat patties in ambient temperature which would be a benefit to the meat industry cutting down the refrigeration costs.

ACKNOWLEDGEMENT

The authors acknowledge the Ministry of Food Processing Industries, Government of India for the financial grant and Tamil Nadu Veterinary and Animal Sciences University for providing the institutional support for carrying out this research work.

Conflict of interest: None.

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