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Efficiency of Arabic gum, red pepper and salt on increasing the shelf life of dry camel meat

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Abstract

This study examined the effects of Arabic Gum, Red Pepper, and Salt on total bacterial count (TBC) and *E. coli* count in dried camel meat, conducted at the University of Bahri, Sudan. Camel meat, valued for its low fat and high polyunsaturated fatty acid content, has limited shelf life due to microbial and enzymatic spoilage. Five Kg of sliced camel meat were divided into four groups three treated with Red Pepper, Arabic Gum, and Salt (40g each), and one untreated control then dried for one, seven, and thirty days. Bacterial counts were assessed using a completely randomized design with three replicates. Results showed significant differences ($P \leq 0.05$) in TBC and *E. coli* counts across treatments and time points, with Salt proving most effective in reducing both. TBC and *E. coli* counts declined progressively across all treatments, with Salt showing the lowest final counts. The study concludes that salt treatment effectively minimizes microbial contamination, thereby enhancing the shelf life of dried camel meat.

Keywords: Dry camel meat, Arabic gum, red pepper, *Escherichia coli*, shelf life

1. Introduction

The most highly considerable characters of the camel meats are its low-fat matter and high moisture content and also considered as rich in protein content and a multi vitamin commodity. As camel meat contains less fat, therefore suggest that eating camel meat is a great factor helps reducing risk of developing life-threatening diseases, such as obesity, cholesterol disease and colon cancer (Bernabucci U, Basiricò L, 2013) ^[3].

1.1 Methods of meat preservation

One of the ways of preserving meat is post-harvest processing. Processed meat is that in which its fresh properties are modified by use of one or more procedures such as grinding, addition of seasoning, heat treatment or drying (FAO 1995) ^[4]. Processing helps to enhance meat quality as well as elongate its shelf-life (Ogunsola. & Omojola 2006) ^[8].

1.2 Total count bacteria

Although there has been growing attention being paid to camel meat globally, outbreaks of food borne diseases in developing countries can be unrecognized (Schirone, Visciano *et al.* 2017) ^[10] probably because of the poverty, the lack of infrastructure and the lack of resources for food safety management and food control services.

Generally, meat can be prone to microbial spoilage and can harbour a wide variety of food borne and zoonotic agents, such as *Staphylococcus aureus*, and *Enterococcus* spp. All these pathogens can be harboured within the gastrointestinal tract of food-producing animals and, hence, contamination to meat during the processing at an abattoir, with subsequent human illnesses, is a rational expectation (Naas, Almajdoubi *et al.* 2017) ^[7] Several other bacterial zoonotic pathogens may exist and have been described already in different camel samples such as *Salmonella*, the Shiga toxin producing *E. coli* (O157:H7 and other serotypes), *Listeria* and

Clostridium difficile (Bautista-Gallego, Arroyo-Lopez *et al.* 2008) [2].

Antimicrobial reagents are indispensable in the world of food preservation, offering enhanced food safety, extended shelf life and significant contributions. As science and technology continue to advance, the future of food preservation will likely see the development of innovative antimicrobial solutions, contributing to safer and more sustainable food supplies worldwide. The careful balance of science, regulation and consumer awareness will be essential in harnessing the full potential of antimicrobial reagents for the benefit of society. (Argucia, Florina. 2023) [1].

2. Materials and Methods

2.1 Study area

The study was conducted at the Laboratory of Animal Production, College of Animal Production, University of Bahri, Khartoum North Sudan.

2.2 Methods of samples collection

Camel meats used in this study were collected from Khartoum market. A total of 5 kg samples and (40 gm of chili pepper, gum Arabic and salt respectively, the samples were immediately transferred from market to laboratory (lab of the College of Animal Production, University of Bahri). The samples were divided to slices for four group each group have control, and added salt, chili pepper and Arabic gum. Then transferred for dry by the sun under the shelter due to autumn season and left for one day, seven days and thirty days. Sterile containers were used to collect the samples. Each sample was collected separately. Isolation and Identification of Bacteria according to methodology of (Oxoid. 1998) [9].



Fig 1: The Control Sample



Fig 2: Sample treated by Red paper



Fig 3: Sample treated by Salt



Fig 4: Sample treated by Arabic Gum

2.2 Methods of sterilization

2.3.1 Dry heat

A hot air oven was used to sterilize clean glass containers, which were placed in stainless steel cans, at a temperature of 160°C for one hour. Flaming was used to sterilize the mouths of bottles, cotton-plugged tubes, and glass slides; this was done by exposing the object to a direct flame for approximately 0.5-1 second.

2.3.2 Moist heat

Autoclave was used to sterilize media and materials that could not withstand dry heat. The temperature was 115 -121°C under 10 - 15 psi (pounds per square inch) for 15-20 minutes

2.4 Culture media

2.4.1 Liquid media

Nutrient broth medium: Thirteen grams of the dehydrated medium (Oxoid) were added to 1 L of distilled water and brought to boiling until completely dissolved. The pH was adjusted to 7.4 ± 0.2 . The medium was distributed into test tubes in 5 mL volumes and sterilized by autoclave at 121°C for 15 minutes.

2.4.2 Solid media

Nutrient agar medium: Twenty-eight grams of nutrient agar powder (Oxoid) were added to 1 L of distilled water and brought to boiling until completely dissolved. The pH was adjusted to 7.4 ± 0.2 . The medium was sterilized by autoclave at 121°C for 15 minutes, aseptically distributed into sterile petri dishes in 15-20 mL portions, and left to solidify.

Sterile test tubes and medium



Fig 5: Sterile test tubes

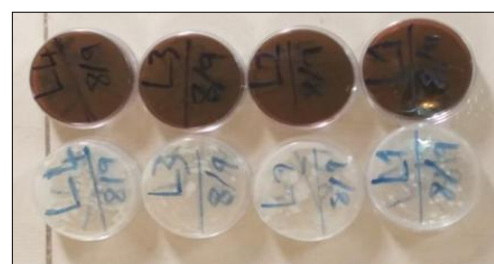


Fig 6: Medium tubes

2.5. Statistical analysis

The data of this study were analyzed using complete randomized design (CRD) using one way (ANOVA). with differences considered statistically significant at $P \leq 0.05$.

3. Results and Discussion

Tale 1: Indicated the (T.B.C) in dry camel treated by Red pepper, Arabic Gum and Salt.

Treatments	Treated period / Days		
	One	Seven	Thirty
Control	1416.17±10 ^a	766.67±25 ^b	436.67±14 ^b
Red Pepper	1200.00±50 ^a	533.33±20 ^b	266.67±37 ^c
Arabic Gum	1166.67±12 ^a	666.67±25 ^b	296.67±73 ^c
Salt	933.33±57 ^a	466.77±6 ^b	143.33±45 ^b

Values (mean± sd) with different superscript letters within the same column are significantly different at $P \leq 0.05$, NS = No significant difference (according to [ANOVA]).

Table (1) presents the total bacterial count (CFU/g) in dry camel meat treated with Red Pepper, Gum Arabic, and Salt, compared to a control group. A general trend of decreasing TBC was observed across all samples, including the control, as the storage period progressed from day one to day thirty. This reduction is primarily attributed to the inherent effect of the drying process, which lowers water activity (a_w), thereby inhibiting microbial growth and promoting the die-off of microorganisms due to osmotic stress and desiccation and this is agree with (Argacia, Florina. 2023) [1].

The results of this study revealed that, the treated samples consistently exhibited lower TBC values than the control at each time point, indicating the additional antimicrobial

benefits of the added preservatives. Also the study showed that, Salt was the most effective treatment, yielding the lowest TBC values throughout the study. On day one, the salt-treated samples had a TBC of 933.33±57 CFU/g, which further decreased to 143.33±45 CFU/g by day thirty. The primary antimicrobial mechanism of salt (sodium chloride) in food preservation is its ability to create osmotic pressure, drawing water out of microbial cells and inhibiting their growth and this similar to that reported by (Argacia, Florina. 2023) [1]. While Red Pepper treatment showed the next most significant reduction, with TBC decreasing from 1200.00±50 CFU/g on day one to 266.67±37 CFU/g on day thirty. Spices like red pepper contain various bioactive compounds, including capsaicinoids and phenolic compounds, which possess antimicrobial properties against common food spoilage microorganisms as well this result agree with and (Gottardi D, et al. 2016 and Stabnikova, O., Stabnikov, V. & Paredes-López, O. 2026) [5, 11]. These compounds can disrupt bacterial cell membranes and interfere with metabolic processes (Lee NK, Paik HD 2016) [6].

However Arabic Gum also contributed to reducing TBC, with counts decreasing from 1166.67±12 CFU/g to 296.67±73 CFU/g over the 30 days. While specific direct antimicrobial mechanisms of gum arabic are less commonly cited than those of salt or red pepper, it is often used as a coating agent. It can form a protective barrier that reduces oxygen exposure and moisture loss, thereby indirectly inhibiting microbial growth and enhancing the preservative effect Lee NK, Paik HD (2016) [6]. The presence of some natural antimicrobial compounds in gum arabic itself may also contribute to its preservative effect.

Table 2: Indicated the *E.Coli* (CFU/g) in dry camel treated by Red pepper, Arabic Gum and Salt.

Treatments	Treated period / Days		
	One	Seven	Thirty
Control	500.00±36 ^{NS}	149.67±13	345.67±56
Red Pepper	321.67±16 ^a	56.67±74 ^b	14.00±9 ^b
Arabic Gum	413.33±26 ^{NS}	106.41±16	10.00±5
Salt	35.67±30 ^{NS}	15.67±10	9.67±5

Values (mean± sd) with different superscript letters within the same column are significantly different at $P \leq 0.05$, NS = No significant difference.

Table (2) details the *E. coli* count (CFU/g), an important indicator of contamination and hygiene, in the dry camel meat.

Furthermore the study showed that on day one, the control sample had an *E.coli* count of 500.00±36 CFU/g. In totally contrast, Salt treatment drastically reduced this to 35.67±30 CFU/g, demonstrating its immediate and potent inhibitory effect on *E.coli* through osmotic stress and this agree with (Argacia, Florina. 2023) [1]. While Red Pepper and Gum Arabic also showed initial reductions, to 321.67±16 CFU/g and 413.33±26 CFU/g, respectively, compared to the control. Over the 30-day storage period, *E. coli* counts significantly decreased in all treated groups. By day thirty, *E. coli* levels were remarkably low in the Red Pepper 14.00±9 CFU/g), Gum Arabic 10.00±5 CFU/g), and Salt 9.67±5 CFU/g) treated samples. This indicates that these treatments were highly effective in controlling *E. coli* over extended storage.

Conversely, the control group maintained a relatively high *E. coli* count of 345.67±56 CFU/g even after 30 days, suggesting that drying alone was insufficient to eliminate this specific pathogen. This highlights the critical role of antimicrobial additives in ensuring the microbiological safety of dried meat products.

The statistical difference indicated by 'a' and 'b' for Red Pepper treatment across days suggests a consistent and significant reduction in *E. coli*, reinforcing its efficacy. The "NS" (non-significant) notation for some control and Gum Arabic/Salt values on day one implies higher variability, which may warrant further investigation or larger sample sizes in future studies.

4. Conclusion

From the above results, it can be concluded that the results indicate that all three natural additives significantly reduced microbial loads compared to untreated control samples, with salt demonstrating the most pronounced inhibitory effect on both TBC and *E. coli*. Red pepper also showed strong antimicrobial activity, particularly against *E. coli*, while Arabic gum provided a moderate reduction in bacterial counts, likely due to its barrier properties.

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