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Effect of Cranberry on Sensory and Bacteriological Quality of Shish Tawook under Chilling Storage

Esraa A.H. Gharib[1*], Ali M. Ahmed[1], Heba M. Shaheen[1], Nada I.H. Ahmed[1], Mariem A. Abdel-Wahab[2]

[1]Department of Food Hygiene, Faculty of Veterinary Medicine, Suez Canal University, Egypt.

[2]Department of Food Safety and Technology, Faculty of Veterinary Medicine, Minia University, Egypt.

***Correspondence**
Corresponding author: Esraa A.H. Gharib
E-mail address: easraaadel@gmail.com

Abstract

Chicken meat is well-thought-out an essential vehicle of foodborne diseases. Consequently, food investigators all over the world have been challenged for seeking safe methods for elimination of food-borne illness from food products of animal origin. Therefore, this study had been carried out to provide an overview about using craneberry as natural preservative for controlling of total aerobic bacterial count and *L. monocytogenes* in marinated Shish Tawook under chilling storage. Cranberry powder at 5% concentration enhances the flavor, color and tenderness of Shish Tawook samples in compared to control. The results confirmed that adding 5% concentration of cranberry solution significantly ($P<0.05$) reduce the total aerobic bacterial counts in Shish Tawook samples in compared to adding of cranberry powder or 2.5% of cranberry solution. adding 5% concentration of cranberry solution significantly ($P<0.05$) reduce the *L. monocytogenes* counts in Shish Tawook samples in compared to adding of cranberry powder or 2.5% of cranberry solution. The results of the current study concluded adding cranberry powder or 2.5% and 5% cranberry concentrations to Shish Tawook had no adverse effect on the sensory parameters but rather improved those sensory parameters, which led to consumer prefer it. The powder has an inhibitory effect on total aerobic bacterial count to a large extent, protecting the consumer from meat spoilage, while it had a lethal effect on *L. monocytogenes*, which confirms the safety of the product for human consumption.

KEYWORDS
Cranberry, *L. monocytogenes*, Total bacterial count, sensory.

INTRODUCTION

Shish Tawook, chicken thigh with their fat, is a chicken thigh produced via way of removal an entire leg on the joint among the tibia and the femur including removal of drumstick and patella. Meat adjoining to the ilium may also or might not be present. Shish Tawook offers a significant amount of biologically valuable animal protein for consumers of all ages since they include all of the necessary amino acids needed for good human health. In addition, a high percentage of unsaturated fatty acids, vitamins such as niacin, riboflavin, thiamine, and ascorbic acid, as well as selenium, sodium, calcium, iron, phosphorus, sulfur, and iodine (Abou Hussein, 2007).

Bacterial contamination of Shish Tawook can occur as a result of the microbial qualities of raw materials used in their production, as well as inappropriate handling during shipping, processing, storage, and distribution (Colak *et al*., 2011). One of the main serious challenges impacting human health and food safety is foodborne diseases caused by bacterial contamination (Wu *et al*., 2016). Bacteria cause two-thirds of the food-borne disease outbreaks, despite the fact that there are over 250 distinct food-borne diseases (Argaw and Addis, 2015).

Aerobic plate count can provide useful information about the remaining shelf-life of the food in question, and thus highlight potential problems of storage and handling since production (HPA, 2009). Aerobic plate count provides a general indication of food microbiological quality but not safety (NSW/FA, 2009).

L. monocytogenes is very dangerous gram positive aerobic bacteria commonly found in Shish Tawook. Listeriosis has the highest case fatality rate and may cause abortion in females. In neonates, it could lead to septicemia or meningitis and is often fatal, while in immune compromised populations it could cause meningitis, encephalitis, meningoencephalitis and septicemia (Bell and Kyriakides, 2005). *L. monocytogenes* cause a mutidimential potential threats that due to existence of multidrug resistant isolates, which transfer antibiotic resistance to the community (Jamshidi and Zeinali, 2019).

Cranberry is derived from the Middle Low German kraanbere (English translation, craneberry), which was originally identified in English as cranberry by the missionary John Eliot in 1647. Around 1694, German and Dutch colonists in New England used the term "cranberry" to describe the expanding blossom, stem, calyx, and petals that resembled a crane's neck, head, and bill.

The original English name for the more widespread plant in Europe, *Vaccinium oxycoccos*, fenberry, came from bushes with little red berries found growing in England's fen (marsh) regions. Cranberries are a subgenus of the Vaccinium genus that consists of evergreen dwarf shrubs or trailing vines. There are many uses of cranberry that may improve quality and safety of food (Caruso *et al*., 2000).

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The ability of cranberry polyphenolic classes to reduce lipid oxidation in mechanically separated turkey and cooked minced pork. According to the study reported that, mechanically separated turkey treated with cranberry juice powder at 0.32% inhibited lipid oxidation (Lee *et al*., 2006). Berry phenols and other components, such as vitamin C, have potent antioxidant properties ,vitamin C is also important in the prevention and treatment of oral infectious disorders such as periodontitis (Sigusch, 2013).

Extracts made from natural berries have been discovered to have great anti-cancer action due to their high level of antioxidants (Kranz, *et al*., 2020). Berry phenols have been found to specifically inhibit the proliferation of certain human pathogenic bacteria (Franco and Vazquez, 2020). Additionally; one of the potent natural anti-microbial agents is Cranberry extract which has anti-bacterial properties against *Listeria monocytogenes*.

Therefore, this study had been carried out to provide an overview about using craneberry as natural preservative for controlling of total aerobic bacterial count and *L. monocytogenes* in marinated Shish Tawook under chilling storage.

MATERIALS AND METHODS

Cranberry

50 g freeze-dried powder, raw, gluten-free was used in this study. A total of 900g of chilled Shish Tawook samples were divided into 3 groups, each group containing (300g). All groups were salted as regular by adding 1.7% NaCl (food grade). The 1st group (group A) was kept as control, the 2nd group (group B) was treated by adding 2.5% of cranberry solution, while the 3rd group (group C) was treated by adding 5% of cranberry solution. Then, all groups were kept to marinate at 4°C for one hour.

Sensory evaluation

The procedure recommended by ASTM (1969) was used for sensory evaluation of the Shish Tawook samples. Ten Panelists were asked to sign a consent form. Shish Tawook samples were grilled on electric griller for 20 minutes then acceptance testing was used to determine how much each sample was liked based on 5 points according to guidelines cited below for a set colour, flavor and tenderness, where 5 means like excellent and 1 means dislike poor. Sensory Schema as the following: 5= Improve color, flavor and tenderness, 4= No sensible change in natural color, flavor and tenderness, 3= Sensible discoloration, slightly flavor and medium tenderness, 2= No nature color, moderately, off-flavor and low tenderness, 1= Sharply sour and extremely rancid flavor extremely toughness.

Determination of Total bacterial counts

Three of 3M Petrifilm Rapid aerobic Count Plate were placed on level surface. The top films was lifted and with the pipette perpendicular 1mL of Shish Tawook samples suspension of each group (group A, group B and group C) was dispensed onto the center of bottom of each three films, respectevily. The top films were dropped down onto the sample. With ridge side down, 3M™ Petrifilm™ Spreader was placed on top films over inoculum. Gently pressure was applied on 3M petrifilm spreader to distribute inoculum over circular area before gel is formed. 3M petrifilm spreader was lifted. Plate was left undisturbed for at least one minute to permit the gel to form. Plates were incubated with clear side up in stacks of up to 24±2 h at 35±1°C.

Determination of Total Listeria counts

Three of 3M Petrifilm environmental *Listeria monocytogenes* (EL) plate were placed on level surface. The top films was lifted and with the pipette perpendicular 1mL of Shish Tawook samples suspension of each group (group A, group B and group C) was dispensed onto the center of bottom of each three films, respectevily. The top films were dropped down onto the sample. With ridge side down, 3M™ Petrifilm™ Spreader was placed on top films over inoculum. Gently pressure was applied on 3M petrifilm spreader to distribute inoculum over circular area before gel is formed. 3M petrifilm spreader was lifted. Plate was left undisturbed for at least one minute to permit the gel to form. Plates were incubated with clear side up in stacks of up to (28±2h at 37±1°C).

Statistical analysis

Data analysis was performed by using SPSS statistical software program (SPSS, 2016). Any significant differences ($P<0.05$) between means were analyzed using a level of significance of alpha = 0.05.

RESULTS AND DISCUSSION

Sensory evaluation of Shish Tawook treated with cranberry

Food preservatives have been employed to lengthen food shelf-life, although they are closely controlled due to toxicological concerns and certain health issues. As a result, finding effective and non-toxic methods that decrease bacterial count, improve quality and food safety and increase the shelf-life of poultry meat is becoming increasingly appealing (Candan and Bağdatlı, 2017).

Statistically results of sensory Shish Tawook samples scores for different concentrations of cranberry against flavor (Table 1). The mean flavor score values for Shish Tawook samples treated with 0% (control), 2.5% and 5% concentration of cranberry were 4.40, 4.20 and 4.40 respectively. In Table 2, the mean color score values for Shish Tawook samples treated with 0% (control), 2.5% and 5% concentration of cranberry were 4.00, 4.30 and 4.50 respectively. In Table 3, the mean tenderness score values for Shish Tawook samples treated with 0% (control), 2.5% and 5% concentration of cranberry were 4.40, 4.20 and 4.40 respectively. It obviously that cranberry powder at 5% concentration enhances the flavor, color and tenderness of Shish Tawook samples in compared to control.

Table 1. Statistical results of sensory Shish Tawook samples scores for different concentrations of cranberry against flavor.

	Cranberry		
	Control	2.5%	5%
Minimum	3	3	3
Maximum	5	5	5
Mean	4.20^{a}	4.30^{b}	4.60^{c}
*± S.E.	0.25	0.26	0.16

The different letter in the same row is considered significantly different ($P<0.05$).
The P value is 0.4470, it is considered not significant variation among columns means.

Addition of cranberry had no adverse effect on the overall sensory quality of the burgers and cooked ham, although it caused some colour changes (Tamkutė *et al*., 2019). Cranberry with different concentrations significantly improved the colour,

odour, taste, texture, and overall acceptability of minced meat samples stored at 3±1°C for 6, 9, and 12 days, respectively (Arboud *et al*., 2023).

Table 2. Statistical results of sensory Shish Tawook samples scores for different concentrations of cranberry against color.

	Cranberry		
	Control	2.5%	5%
Minimum	3	3	3
Maximum	5	5	5
Mean	4.00[a]	4.30[b]	4.50[c]
*± S.E.	0.21	0.21	0.27

The different letter in the same row is considered significantly different (P<0.05).
The P value is 0.4470, it is considered not significant variation among columns means.

Table 3. Statistical results of sensory Shish Tawook samples scores for different concentrations of cranberry against tenderness.

	Cranberry		
	Control	2.5%	5%
Minimum	4	3	3
Maximum	5	5	5
Mean	4.40[a]	4.20[a]	4.40[a]
*± S.E.	0.16	0.25	0.27

The P value is 0.7806, it is considered not significant variation among columns means.

Plant extracts are known to be a combination of several phenolic chemicals notable for their antioxidant action. Several plants were therefore evaluated for this action, as well as how their extract acts in poultry products (Chammem *et al*., 2015). One drawback of using chemicals in chicken meat marinades is that they may produce odors or flavors that are not typical of chicken meat. Sensory assessment is thought to be an appropriate tool for detecting these discrepancies (Fellenberg *et al*., 2011). Cranberry juice contains a high concentration of polyphenols, making it an important raw material with health-promoting characteristics. Cranberry's bitter and astringent flavour, on the other hand, limits its use in fresh form (fruit, juice). As a result, novel formulations of cranberry products based on natural additives are being explored, such as in the form of carriers, which not only allow the drying of liquids to form powders but also allow the drying of powders to produce liquids (Michalska-Ciechanowska *et al*., 2020). The polyphenol content impacts the bitter and astringent taste of cranberry fruits, making them unappealing as a diet component, especially in fresh form.

As a result, several attempts have been undertaken to transform cranberry into a food additive without the undesirable flavor for customers and the harmful impact on the finished product. Cranberry is available on the market as a component in tea infusions, as an osmotically dehydrated product in a sugar solution, as a powder product (to reduce bitterness), and even as cranberry snacks (Nowacka *et al*., 2019).

Powders made from cranberry juice or extracts might be the next generation of cranberry products. Because of the particular mix of bioactive elements, such products might be employed as food additives or nutraceuticals (Michalska *et al*., 2018). The manner of juice preparation has a direct impact on the quality of such products (Côté *et al*., 2011). The drying technique utilized, and the parameters used for their manufacturing. The ability to powder fruit juices is tightly linked to the presence of organic acids and low-molecular-weight molecules, which hinder juice powder conversion due to the relatively low glass transition temperature, strong hygroscopicity, and so on (Bhandari *et al*., 1993).

Such challenges may be solved by the use of a carrier that allows for the creation of fruit juice powders, Maltodextrin is a popular carrier used in the manufacturing of powders (Michalska-Ciechanowska *et al*., 2020). Maltodextrin is a superior carrier agent than, for example, inulin from a technical standpoint, because maltodextrin has a lesser tendency to condense the solution prior to the spray-drying process (Michalska *et al*., 2018). Maltodextrin is currently used as a fat substitute, decreasing the calorie content of some foods (Kasprzyk *et al*., 2016). Maltodextrin is classified according to the kind of starch used for hydrolysis, such as potato, rice, corn or oat; alternatively, barley and wheat are examples of less typically utilized forms of starch (Fortuna and Sobolewska, 2000).

Carriers should be utilized with caution because to their impact on biological characteristics in vivo. The use of combinations of different carriers may give a technical benefit, since such a combination of carriers can be good for drying owing to particle formation as well as the final physical qualities of the powders formed. Because of growing consumer awareness of the need of living a healthy lifestyle, there is a demand for the use of a carrier that may provide additional advantages for human health in addition to facilitating the drying process (Michalska-Ciechanowska *et al*., 2020). In addition to the effect of the carrier agent, the drying technique and the parameters used should be considered when determining the quality of fruit powders.

Cranberry juice powders are now produced using freeze-, vacuum, and spray-drying methods (Michalska *et al*., 2018). When compared to other drying processes, spray-drying improved polyphenolic component retention, with values comparable to those obtained following freeze-drying. The findings revealed that the moisture content of powders was highly depending on the drying process used. The moisture content of freeze-dried powders was roughly eight times greater than that of spray-dried powders (Michalska-Ciechanowska *et al*., 2020). Scientific assessments based on the following criteria: 1. Natural, possibly of plant or botanic origin, with recognized antioxidative and antimicrobial properties; 2. commercially available, accessible through the market of ingredients and additives for the food industry; and 3. Compatible with poultry meat products, with no adverse effect on technological or sensory properties (Hung *et al*., 2016).

Cranberry juice can be an effective preservation, source of natural antibacterial, to protect RTE foods from foodborne pathogen contamination without affecting sensorial properties of treated samples, allowing RTE foods to keep their freshness, sensory, and nutritional quality (Harich *et al*., 2017). There are no statistically significant differences in texture and color of broiler chicken fed 0 to 160 mg/kg of cranberry fruit extract in feed (Lesusink *et al*., 2010).

Total aerobic bacterial count for Shish Tawook treated with cranberry

Statistically results of total aerobic bacterial counts for Shish Tawook samples treated with different concentrations of cranberry (Table 4). The mean values for control samples, samples treated with cranberry powder, samples treated with 2.5% cranberry solution and samples treated with 5% cranberry solution were $2.1x10^5$, $1.6x10^5$, $1.2x10^4$ and $2.3x10^4$ cfu/g respectively.

The results confirmed that adding 5% concentration of cranberry solution significantly (P<0.05) reduce the total aerobic bacterial counts in Shish Tawook samples in compared to adding of cranberry powder or 2.5% of cranberry solution.

Cranberry supplementation substantially slowed the proliferation of aerobic plate counts, according to the findings (Arboud

et al., 2023).

Table 4. Statistical results of total bacterial counts for different concentrations of cranberry in Shish Tawook sample.

	Control	Cranberry		
		Powder	2.5%	5%
Minimum	$4x10^3$	$3.5x10^3$	$2.5x10^3$	$2.3x10^3$
Maximum	$1.2x10^6$	$9x10^5$	$7x10^5$	$6.7x10^5$
Mean	$2.1x10^5$	$1.6x10^{5a}$	$1.2x10^{4b}$	$2.3x10^{4c}$
*± S.E.	$3.8x10^4$	$37x10^3$	$2.5x10^2$	$4.8x10^2$

The different letter in the same row is considered significantly different (P<0.05).
The P value is 0.4470, it is considered not significant variation among columns means.

The addition of cranberry powder to fermented sausage may boost the safety of the fermented sausage products by successfully inhibiting the growth of aerobic bacteria. As a result, cranberry powder might serve the same purpose as nitrite (colour protection and bacteriostatic). In fermented sausage and might be utilised as a natural replacement the use of nitrite in fermented sausage. The main cause for this effect was the antioxidant activity of cranberry powder that limit microbial metabolism and the development of oxidation reactions in samples (Yang *et al*., 2023).

Cranberry substantially prevented the development of aerobic mesophilic bacteria at concentrations more than 3.3% (Tamkutė *et al*., 2019). Natural preservatives, particularly herbs or plant extracts, (as cranberry) are appropriate for use in food products (Shan *et al*., 2009). As a result, cranberry might be employed as multifunctional preservatives in a variety of food products, demonstrating beneficial technical qualities such as increased shelf-life and improved characteristics (Daoutidou *et al*., 2021).

The most important compounds of the cranberry are polyphenols, they are the most attractive and important natural substances to be utilized as food preservatives and bioactive additives due to their great antioxidant capacity. As a result, there have been a huge number of researches relevant to the utilization of polyphenol bearing medicinal plants to date (Bakirtzi *et al*., 2016). The primary focus of research is on bioactive chemicals, and their abundance in natural matrices obviously dictates their choice (Candan and Bağdatlı, 2017).

Flavonols, flavan-3-ols, anthocyanins, tannins (including ellagitannins and proanthocyanidins), and phenolic acid derivatives are the most abundant bioactive phenolic chemicals discovered in cranberry (Jiao *et al*., 2017). Cranberry phenolic substances are mostly present in the seeds and skins. Proanthocyanidins are prevalent in both tissues; however changes in their composition have been documented depending on the tissue. Grape skins contain both procyanidins and prodelphinidins, whereas seeds strictly contain procyanidins. Grape phenolic content is well known to change during ripening, and it is critical to consider this when selecting the best vintage moment. To characterize the concentration of phenolic substances in grapes, both skins and seeds, and the ease with which they are released, the term "phenolic maturity" was suggested by Quijada-Morín *et al*. (2016).

Proanthocyanidins (PAs) are a kind of polyphenol that occurs naturally as oligomers or polymers of polyhydroxy flavan-3-ol units such as (+)-catechin and (-)-epicatechin. They are commonly found in red wine, fruits and vegetables, nuts, seeds, and barks. PAs have been shown to have a variety of biological effects in vitro and in vivo as natural antioxidants. Grape seeds are a very rich source of PA, including virtually entirely procyanidins that have been partially esterified by gallic acid (Candan and Bağdatlı *et al*., 2017).

Total L. monocytogenes count for Shish Tawook treated with cranberry

Statistically results of *L. monocytogenes* for Shish Tawook samples treated with different concentrations of cranberry are presented in Table 5. The mean values for control samples, samples treated with cranberry powder, samples treated with 2.5% cranberry solution and samples treated with 5% cranberry solution were $3x10^2$, 150, 120 and < 10^2 respectively.

Table 5. Statistical results of *Listeria monocytogenes* for different concentrations of cranberry in Shish Tawook sample.

	Control	Cranberry		
		Powder	2.5%	5%
Minimum	< 10^2	<10^2	<10^2	< 10^2
Maximum	$2x10^3$	$1.5x10^3$	$6x10^2$	< 10^2
Mean	$3x10^2$	150^a	120^b	< 10^{2c}
*± S.E.	$3x10^1$	<10^2	<10^2	< 10^2

The different letter in the same row is considered significantly different (P<0.05).
The P value is 0.4470, it is considered not significant variation among columns means.

The results confirmed that adding 5% concentration of cranberry solution significantly (P<0.05) reduce the *L. monocytogenes* counts in Shish Tawook samples in compared to adding of cranberry powder or 2.5% of cranberry solution. Experimentally, in agar diffusion studies, cranberry exhibited a distinct inhibitory zone against *L. monocytogenes* (Lin *et al*., 2004).

Cranberry substantially prevented the development of pathogenic *L. monocytogenes* at concentrations more than 3.3% (Tamkutė *et al*., 2019). *Listeria monocytogenes* is a bacterial infection transmitted mostly via food. The pathogen is well-known around the world for its ability to flourish in high salinity (10%), low water activity (0.9), low temperature (4°C), and a pH range of 4.1-9.6 (Guenther *et al*., 2009). As a result, it can live in processing equipment, packaging materials, food contact surfaces, and so on. Food processing, in particular, is regarded as the most major source of *L. monocytogenes* contamination (Buchanan *et al*., 2017). *L. monocytogenes* is now often discovered in a wide range of food products, particularly those of originated in animals, with a plethora of isolated strains being resistant to antibiotics (Henri *et al*., 2016). A plethora of researches suggests that resists to stress in *L. monocytogenes* affect pathogenesis (Mains *et al*., 2021).

Consumers are increasingly demanding safer and more natural goods, particularly in the food, cosmetic, and pharmaceutical industries. One of the most important opportunities to meet these needs is the utilization of plant extracts, which have been shown to be helpful as topping, food, sources of colors and flavors, and have been linked to medicinal characteristics (Candan and Bağdatlı, 2017). Herbs as cranberry from various growing zones have varying amounts of chemical components and hence have varying medicinal benefits (Urbizu-Gonzàlez *et al*., 2017). Recent researches have focused on finding of new antimicrobial derived from natural sources.

Cranberry is strong in biologically active components, including procyanidins, anthocyanins, phenolic acids, flavonols, and flavan-3-ols, which are the reason for its high antioxidant capacity (Michalska *et al*., 2018). It has been proven that the American cranberry (*Vaccinium macrocarpon* Ait.) contains 13 anthocyanins (which are primarily responsible for the fruit's colour), 23 distinct proanthocyanidins, and 14 flavonols, the majority of which being quercetin, myricetin, and keampferol (Blumberg *et al*., 2013). It has also been demonstrated that the pomace contains around 5% of

the total flavonol content of the cranberry fruit after processing (White, 2011). According to Oszmianski *et al*. (2016), regardless of the cultivars examined, the leaves and pomace contained more polyphenolic compounds and had stronger antioxidant activity than the fruit and juices.

Even so, as has been demonstrated on whole fruits, cranberry is a significant source of phenolic compounds such as anthocyanins, proanthocyanins, and flavonoids, which have numerous beneficial properties such as antioxidants, antimicrobials, anticarcinogens, and inhibitors of bacterial adhesion in some human organs (Blumberg *et al*., 2013).

CONCLUSION

Adding cranberry powder or 2.5% and 5% cranberry concentrations to Shish Tawook has no adverse effect on the sensory parameters but rather improved those sensory parameters, which led to consumer prefer it. The cranberry powder had an inhibitory effect on total aerobic bacterial count to a large extent, protecting the consumer from meat spoilage, while it haS a lethal effect on *L. monocytogenes*, which confirms the safety of the product for human consumption.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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