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Evaluating the effect of *Citrullus colocynth* extracts as natural preservatives for some Chevon meatballs

Nagwa Thabet Elsharawy[*1,2], Afnan Ahmed Allhyani[3], Mohamed Baeshen[3]

[1]*Department of Movement Science & Health, College of Sport Science, University of Jeddah, Saudi Arabia*

[2]*Department of Food Hygiene, Faculty of Veterinary Medicine, New Valley University, Egypt*

[3]*University of Jeddah, Collage of Science, Department of Biology, Jeddah, Saudi Arabia*

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Abstract

Chevon is one of the most favorable meats between Arabian populations. Its consider one of the primary source of protein, fat, and water, which providing all essential amino acids, micronutrients, vitamins B6, B12, vitamin D, omega-3 polyunsaturated fatty acids, which makes it best media for growth of microorganism and highly perishable food item. That increasing the demand to find safe materials extending the shelf life of meat. The aim of the study is to examine *Citrullus colocynthis* extract as natural preservatives. Fifty chevon samples were investigated microbiologically. Then determined the antibacterial effect of *Citrullus colocynthis* (aquas & ethanolic) extracts by different concentrations; (1.25, 2.5, 5, 10, 12.5 & 15) % against six foodborne microorganisms (*Staphylococcus aureus* and *Listeria monocytogenes Escherichia coli, Salmonella typhi, Salmonella enteritidis* and *Vibrio parahaemolyticus*). Finally, addition of the different concretions of each extract to the chevon was performed. On the other side obtained results observed that all extracts have antibacterial effect by varies degree against all tested microorganisms and the extracts successes to extend the shelf life of chevon to about 17 days. According to obtained results indicated that herbal extracts consider a promising choice for the creation as a novel technique to overcome some food pathogens. So, it can be utilized as an alternative to traditional food preservative products.

* **Corresponding Author:** Nagwa Thabet Elsharawy ✉ dr.nagwa2004@yahoo.com

Introduction

Chevon is referred to the goat meat which considers as one of the most favorite edible red meat kind especially for Arabian societies consumers'. Chevon meat differ in nutritional values than beef meat as it has lower saturated fat, cholesterol and calories contents, in addition to its higher potassium and lower sodium contents all that make this meat kind of choice to people suffering from heart disease and other cardiovascular disorders (Singh *et al*., 2014).

On the other hand, chevon deterioration may result by the effect of; the meat enzymatic autolysis, lipid oxidation and/or microbial spoilage. Chevon as all meat kinds is one of the excellent media for microbial growth including foodborne microorganisms due to its nutritional value richness (Heifa'a *et al.,* 2018).

Foodborne pathogens such as; (*Staphylococcus aureus, Escherichia coli, Salmonella typhimurium, Salmonella enteritidis, Listeria monocytogenes* & *Vibrio parahaemolyticus*) in food poses food poisoning problem to the consumers' health (Umesha and Manukumar, 2018). The zoonotic danger may cause by the foodborne microorganisms itself or caused by their toxins which leading to different severity of the illness signs or even death (Heredia and García, 2018; Allhyani *et al*., 2021).

Good preservation considered one of the best methods to avoid and/or retarding the meat spoilage (Sánchez-Ortega *et al.,* 2014). although, there are many chemical preservatives used in food industries but almost of these chemicals have very dangerous side effect on the consumers' health specially to young, old and immunosuppressed consumers, the hazards increase with prolong consumption of the preserved food products which may causing bad effect on liver, kidney in addition to, their teratogenic and carcinogenic. Therefore, almost recent food hygienists and researchers looking for new natural safe preservatives which can prolong the shelf life of the food item and avoid toxicological effect of the traditional preservatives using different plant parts extracts including; leaves, fruits, stems, roots, seeds and bark (Shah *et al.,* 2014; Abo hashem *et al*., 2022).

Citrullus colocynthis is one of cucurbitaceae family which are widely spread characterized by its rough angular stems, lobed leaves, solitary monoecious flowers, its fruit is green turn to yellow when ripe with size similar to small orange size with numerous ovoid, compressed, light yellowish to dark brown smooth seeds and characterized by its; antimicrobial, antioxidant, antidiabetic, anti-inflammatory, gut disorders including gastroenteritis, colic, indigestion, and dysentery with multiple other therapeutic potency without adverse effects on human health but until now there is a wide shortage on them as food natural perservatives (Al-Snafi, 2016; Rani *et al.,* 2017; da Silva and Hussain, 2017). In addition to the nearly absent studies on their effect in chevon preservation. This study aimed to investigate antibacterial effect of *Citrullus colocynthis* different extracts against some food posining pathogens which isolated from chevon samples, Performed sensetivity test by different concentration of each extract and evalute the effect of addition of the plant extracts by different concentrations on minced chevon shelf life.

Material and methods

Plant extraction

Citrullus colocynthis (Fig. 1) collected on 11th of November 2020 from; Al Ghulah (22.0097982, 39.2557409) - Desert conditions, Saudi Arabia. The plants were cleaned, disinfected, and rinsed with distilled water before being dried in the shade. The dried plant material was grounded into fine powder to pass 100 mm sieve. 50 g of the fine powder was soaked in 200 ml of (ethanol and water) with stirring for 48 hr., filtered through double layers of muslin, centrifuged at 9000 rpm for 10 min and finally filtered again through Whatman filter paper No. (41) to attain a clear filtrate. The filtrates were evaporated and dried at 40 C under reduced pressure using rotatory vacuum evaporator. The extract yields were weighted, stored in small bottles in fridge at 5 °C (Mostafa *et al.,* 2018).

Fig. 1. *Citrullus colocynthis*

Bacterial strains and Inoculums preparation

The antibacterial potency of leaf *Citrullus colocynthis* extract (water and ethanol) was investigated by six foodborne pathogens. Two of tested strains were Gram positive (*Staphylococcus aureus* and *Listeria monocytogenes*) and four strains of tested strains were Gram negative (*E. coli, S. typhi*, *S. enteritidis* & *Vibrio parahaemolyticus*) bacteria. All tested foodborne pathogens strains were obtained from the General Authority for Food and Drug Administration in Jeddah, and then subcultured at 35 C/ 24hr. (Hindi *et al.,* 2013).

Estimation of minimum inhibitory concentrations (MIC) of the tested plant extract against tested microorganisms

Using the following concentrations (1.25, 2.5, 5.0, 10.0, 12.5 and 15.0 ml/100 ml) which prepared by dissolving 50 mg in 2.5 ml of ethanol, then sterilized and filtered by filter paper discs (8 mm in diameter). The pathogenic strains suspensions cultured on Mueller-Hilton agar against different concentrations of the plant extracts then incubated at 35 C/24 h. Then measuring the inhibition zones using *Vernier caliper* (Mostafa *et al.,* 2018).

Evaluation of addition of Plants extraction on extension Chevon meat shelf life

Sensory evaluation of the meat samples: evaluation of the food characteristics through the sense of smell, sight, touch, taste, and hearing (Huss 1995). About 500g from each treatment were formed into small meatball. The samples were prepared then given in two forms (raw & cooked) to panel members (n=10) who were not trained in the sensory analysis of meat. Five characteristics point were given to panelists as following: 1. very poor, 2. poor, 3. good, 4. very good, and 5. excellent. Panelists were considered the above points for evaluation of color, flavor, taste and consistency of the meatball samples.

Determination of pH value (Pippen *et al.*, 1965): by Blend 15 g meat muscle with 30 ml distilled water at 27-30 ^{o}C using digital pH meter.

Statistical analysis

All values are presented as means± standard error and other statistical analysis using (SPSS16, 2007).

Results

Statistical Analysis of Antimicrobial activity of Citrullus colosynthis aqueous extract against foodborne microorganisms

According to Table 1 and Fig. 2, the statistical analysis of Antimicrobial activity of *Citrullus colosynthis* aqueous and ethanol extract against different foodborne microorganisms; *Staphylococcus aureus, E. coli, Salmonella typhimurium, Salmonella enteritidis, Listeria monocytogens, Vibrio parahaemolyticus*. From the mentioned result we observed that the more effectiveness concentration of *Citrullus colosynthis* aqueous extract against *Staphylococcus aureus, E. coli, Salmonella typhimurium, Salmonella enteritidis, Listeria monocytogens,* used was 10% followed by 12.5%, 7.5%, 15% & 2.5% then 5% while other concentrations were nearly having no effect. Although antibiotic has nearly similar power of 10% conc. but with some different in measurements.

In case of ethanol extract were the most effectiveness concentration of *Citrullus colosynthis* ethanol extract against the same microorganisms and found the following results; used was 2.5% & 5% while other concentrations were nearly having no effect. Usage of 2.5% of *Citrullus colosynthis* ethanol extract against *Staphylococcus aureus, Listeria monocytogens*. While the potency of 5% of *Citrullus colosynthis* ethanol extract against *E. coli* and *Vibrio parahaemolyticus* has greater effect than antibiotic. In case of *Salmonella typhimurium* 10%, 12.5% & 15% considered the most effective concentrations, the potency of 10% of *Citrullus colosynthis* ethanol extract against *Salmonella enteritidis*.

Table 1. Antimicrobial activity of *Citrullus colosynthis* aqueous & ethanol extract against tested foodborne pathogens

Micro-organisms	Extracts	Antibiotics	Concentration						
			1.25%	2.50%	5%	7.50%	10%	12.50%	15%
Staphylococcus aureus	aqueous extract	5.72±0.53^{***A}	0.00±0.00^{nsE}	1.05±0.28**	0.70±0.15^{*D}	1.23±0.24^{**C}	2.29±0.40^{***D}	1.28±0.29^{**C}	1.10±0.25^{**E}
	ethanol extract	4.35±0.55^{***A}	0.00±0.00^{nsE}	0.46±0.07^{*C}	0.67±0.09^{*C}	0.67±0.00^{nsE}	0.00±0.00^{nsE}	0.00±0.00^{nsE}	0.00±0.00^{nsE}
E. coli	aqueous extract	2.68±0.36^{**A}	0.18±0.04^{nsE}	0.23±0.56^{***C}	1.00±0.23^{nsE}	1.35±0.30^{**D}	1.37±0.29^{nsE}	0.65±0.12^{nsE}	1.35±0.30^{**E}
	ethanol extract	3.75±0.19^{*A}	0.63±0.14^{nsE}	0.00±0.00^{nsE}	0.79±0.93^{***C}	0.45±0.10^{nsE}	1.36±0.25^{nsE}	0.00±0.00^{nsE}	1.27±0.20^{nsE}
Salmonella typhimurium	aqueous extract	4.45±0.34^{***A}	0.26±0.06^{nsE}	1.24±0.30**	0.55±0.12^{nsE}	0.65±0.18^{nsE}	2.23±0.48^{***D}	2.03±0.37^{***E}	0.00±0.00^{nsE}
	ethanol extract	4.19±0.16^{***A}	0.00±0.00^{nsE}	0.00±0.00^{nsE}	0.39±0.09^{*C}	0.53±0.10^{nsE}	0.63±0.14^{***DF}	0.78±0.13^{***EG}	0.88±0.18^{***H}
Salmonella enteritidis	aqueous extract	2.60±0.37^{***A}	0.20±0.03^{*E}	0.35±0.05^{*E}	0.67±0.12^{*E}	1.01±0.15^{*E}	2.63±0.66^{***C}	1.46±0.25^{**D}	1.80±0.42^{***E}
	ethanol extract	3.64±0.11^{*A}	0.00±0.00^{nsE}	0.92±0.14^{*AC}	1.00±0.15^{*AD}	1.03±0.14^{*AE}	1.12±0.18**	1.14±0.04^{nsE}	2.02±0.11^{*G}
Listeria monocytogens	aqueous extract	3.01±0.34^{***A}	0.12±0.02^{nsE}	0.27±0.05^{*C}	0.17±0.03^{nsE}	0.27±0.05^{*C}	0.48±0.12^{nsE}	0.55±0.14^{nsE}	0.82±0.08^{nsE}
	ethanol extract	4.80±0.28^{**A}	0.57±0.13^{nsE}	1.03±0.33^{***C}	1.06±0.21^{*D}	0.52±0.14^{nsE}	1.13±0.27^{**E}	0.00±0.00^{nsE}	0.40±0.12^{nsE}
Vibrio parahaemolyticus	aqueous extract	3.05±0.02^{*A}	0.00±0.00^{nsE}	0.61±0.09^{**C}	0.72±0.15^{**C}	0.85±0.14^{**C}	0.71±0.17^{**D}	0.83±0.14^{**C}	1.94±0.36^{***E}
	ethanol extract	5.48±0.13^{**A}	0.13±0.02^{*E}	0.33±0.04^{*EF}	2.59±0.43^{***C}	1.07±0.22^{**EF}	2.52±0.41^{***D}	0.68±0.15^{**EG}	0.75±0.15^{**E}

±SE followed by a different letter in the line are significantly different (P<0.005). ***= highly significant, **= moderately significant, *= low significant, and ns= non-significant.

Table 2. Sensory evaluation changes on control and *Citrullus colocynthis* water extracts treated Chevon meat samples by different concentrations

Days	Control Chevon Samples								*Citrullus colocynthis* water extract																*Citrullus colocynthis* water extract											
									1.25% concentration								5% concentration								10% concentration								15% concentration					
	Raw				Cooked				Raw				Cooked				Raw				Cooked				Raw				Cooked				Raw				Cooked			
	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH
1	5	5	5	5.85	5	5	5	5.88	5	5	5	5.85	5	5	5	5.88	5	5	5	5.85	5	5	5	5.88	5	5	5	5.85	5	5	5	5.88	5	5	5	5.85	5	5	5	5.88
2	5	5	5	5.88	5	5	5	5.90	5	5	5	5.88	5	5	5	5.91	5	5	5	5.88	5	5	5	5.91	5	5	5	5.87	5	5	5	5.90	5	5	5	5.89	5	5	5	5.92
3	4	4	4	5.91	4	4	4	5.94	5	4	4	5.92	5	4	4	5.94	5	4	5	5.90	5	4	5	5.93	4	4	5	5.90	4	4	5	5.94	4	4	5	5.92	4	4	5	5.94
4	4	3	3	5.93	4	4	4	5.95	5	4	4	5.95	5	4	4	5.97	5	4	5	5.94	5	4	5	5.95	4	4	4	5.93	4	4	4	5.96	4	4	4	5.95	4	4	4	5.98
5	3	2	2	5.95	3	3	3	5.97	5	4	4	5.98	5	4	4	5.99	4	4	4	5.97	4	4	4	5.99	4	4	4	5.98	4	4	4	5.99	4	4	4	5.98	4	4	4	6.00
6	3	2	2	5.98	2	2	2	5.99	4	3	3	6.02	4	3	4	6.04	4	3	4	6.00	4	3	4	6.02	3	3	4	6.01	3	3	4	6.03	3	3	4	6.02	3	3	4	6.03
7	2	1	1	6.20	2	2	2	6.30	4	3	3	6.08	4	3	3	6.11	3	3	3	6.07	4	3	3	6.10	3	3	3	6.03	3	3	3	6.05	3	3	3	6.05	3	3	3	6.07
8	1	1	1	6.50	1	1	1	6.60	3	2	2	6.14	3	2	3	6.17	3	2	3	6.13	3	2	3	6.14	2	2	2	6.06	2	2	2	6.09	2	2	2	6.08	2	2	2	6.11
9	Complete Spoilage								3	2	2	6.22	3	2	2	6.25	2	2	2	6.17	2	2	2	6.19	1	1	1	6.09	1	1	1	6.11	1	1	1	6.13	1	1	1	6.16
10									2	2	1	6.27	2	2	1	6.31	2	1	2	6.22	2	1	2	6.25	1	1	1	6.19	1	1	1	6.25	1	1	1	6.19	1	1	1	6.23
11									1	1	1	6.33	1	1	1	6.35	1	1	1	6.26	1	1	1	6.29	1	1	1	6.26	1	1	1	6.29	1	1	1	6.23	1	1	1	6.26

Evaluation of addition of Citrullus colocynthis water extract to Chevon Samples

The results that showed on Table 2 described the sensory changes that appeared on chilled chevon meat along the chill preservation period before and after cooking in control samples as following; the deterioration signs become very clear on the 7th day as all parameters were bad while the odor and consistency of raw samples were very bad in raw chevon samples, pH were 6.2 and 6.3 in raw and cooked samples. The complete spoilage recoded on the 8th day of chilling the chevon samples, pH was 6.5 and 6.6 in raw and cooked chevon samples.

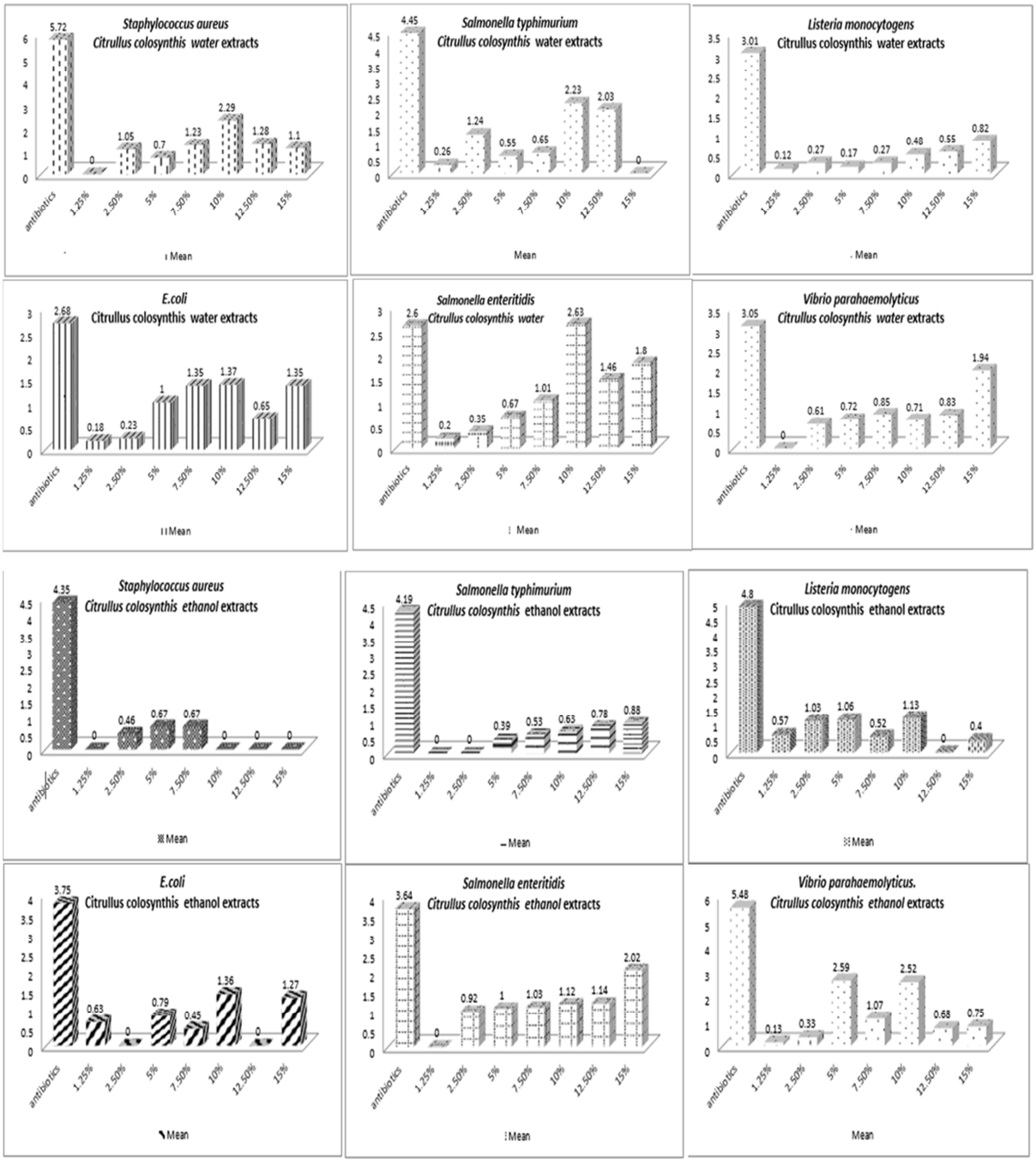

Fig. 2. Antimicrobial activity of *Citrullus colocynthis* leaves different extracts against foodborne microorganisms

Evaluation of addition of Citrullus colocynthis ethanol extract to Chevon Samples

Table 3 described the sensory changes that appeared on chilled chevon meat along 11th days before and after cooking after addition of different concentrations of *Citrullus colosynthis* water extract as following; Almost all parameters became good during the 6th & 7th day of storage except color which remained very good, the pH ranged from 6.02 to 6.11 in raw and cooked samples. The parameters during 10th day become bad except consistency which becomes very bad, pH ranged from 6.27 to 6.31. The deterioration signs become very clear on the 11th day as all parameters were very bad in raw chevon samples, pH were 6.33 to 6.35 in raw and cooked samples. In case of 5% concentration were almost all parameters became very good during the 5th day of storage, the pH ranged from 5.97 to 5.99 in raw and cooked samples. While, during 9th & 10th days become badly except odor which becomes very bad in raw and cooked chevon samples, pH ranged from 6.17 to 6.25.

Table 3. Sensory evaluation changes on control and *Citrullus colocynthis* ethanol extracts treated Chevon meat samples by different concentrations

Days	Control Chevon Samples								*Citrullus colocynthis* ethanol extract																*Citrullus colocynthis* ethanol extract															
									1.25% concentration								5% concentration								10% concentration								15% concentration							
	Raw				Cooked				Raw				Cooked				Raw				Cooked				Raw				Cooked				Raw				Cooked			
	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH	color	odor	Consistency	pH	color	odor	consistency	pH
1	5	5	5	5.85	5	5	5	5.88	5	5	5	5.85	5	5	5	5.88	5	1	5	5.85	5	1	5	5.88	1	1	1	5.85	1	1	1	5.88	1	1	1	5.85	1	1	1	5.88
2	5	5	5	5.88	5	5	5	5.90	5	5	5	5.87	5	5	5	5.90	5	1	5	5.86	5	1	5	5.89	1	1	1	5.89	1	1	1	5.90	1	1	1	5.88	1	1	1	5.90
3	4	4	4	5.91	4	4	4	5.94	5	4	4	5.91	5	4	4	5.95	5	1	5	5.90	5	1	5	5.94	1	1	1	5.91	1	1	1	5.93	1	1	1	5.91	1	1	1	5.93
4	4	3	3	5.93	4	4	4	5.95	4	4	4	5.96	4	4	4	5.97	5	1	5	5.93	5	1	5	5.95	1	1	1	5.93	1	1	1	5.95	1	1	1	5.95	1	1	1	5.96
5	3	2	2	5.95	3	3	3	5.97	4	4	4	5.98	4	4	4	5.99	4	1	5	5.94	4	1	5	5.97	1	1	1	5.97	1	1	1	5.98	1	1	1	5.98	1	1	1	5.99
6	3	2	2	5.98	2	2	2	5.99	4	4	4	6.01	4	4	4	6.05	4	1	5	5.97	4	1	5	5.99	1	1	1	5.99	1	1	1	6.02	1	1	1	6.01	1	1	1	6.03
7	2	1	1	6.20	2	2	2	6.30	3	3	3	6.07	3	3	3	6.09	4	1	4	6.00	4	1	4	6.03	1	1	1	6.02	1	1	1	6.05	1	1	1	6.04	1	1	1	6.07
8	1	1	1	6.50	1	1	1	6.60	3	3	3	6.11	3	3	3	6.13	3	1	4	6.05	3	1	4	6.07	1	1	1	6.07	1	1	1	6.08	1	1	1	6.06	1	1	1	6.08
9									3	3	3	6.18	3	3	3	6.21	3	1	4	6.07	3	1	4	6.09	1	1	1	6.11	1	1	1	6.13	1	1	1	6.08	1	1	1	6.09
10									3	3	3	6.25	3	3	3	6.28	3	1	4	6.11	3	1	4	6.13	1	1	1	6.16	1	1	1	6.17	1	1	1	6.11	1	1	1	6.14
11									2	2	2	6.30	2	2	2	6.32	3	1	4	6.13	3	1	4	6.17	1	1	1	6.20	1	1	1	6.22	1	1	1	6.13	1	1	1	6.16
12									2	2	2	6.33	2	2	2	6.35	2	1	4	6.17	2	1	4	6.20	1	1	1	6.22	1	1	1	6.27	1	1	1	6.17	1	1	1	6.20
13									2	2	2	6.38	2	1	2	6.39	2	1	4	6.21	2	1	4	6.25	1	1	1	6.26	1	1	1	6.28	1	1	1	6.19	1	1	1	6.22
14									2	1	1	6.41	2	1	1	6.43	2	1	4	6.25	2	1	4	6.28	1	1	1	6.30	1	1	1	6.32	1	1	1	6.22	1	1	1	6.23
15									2	1	1	6.44	2	1	1	6.47	2	1	4	6.29	2	1	4	6.33	1	1	1	6.32	1	1	1	6.37	1	1	1	6.25	1	1	1	6.27
16									1	1	1	6.50	1	1	1	6.51	1	1	3	6.35	1	1	3	6.36	1	1	1	6.39	1	1	1	6.40	1	1	1	6.28	1	1	1	6.30
17									Complete Spoilage								1	1	3	6.39	1	1	3	6.43	1	1	1	6.40	1	1	1	6.43	1	1	1	6.31	1	1	1	6.33

Complete Spoilage

The deterioration signs become very clear on the 11th day as all parameters were very bad in raw chevon samples, pH ranged from 6.26 to 6.29 in raw and cooked samples. In case of 10% concentration adding of *Citrullus colosynthis* water extracts all parameters during 8th day become badly in raw and coked chevon sample, pH ranged from 6.06 to 6.09. The deterioration signs become very clear from the 9th day as all parameters were very bad in raw chevon samples, pH were 6.09 and 6.29 in raw and cooked samples. Addition of 15% concentrations *Citrullus colosynthis* water extract all parameters during 8th day become bad in raw and coked chevon sample, pH ranged from 6.08 to 6.11. The deterioration signs become very clear from the 9th day as all parameters were very bad in raw chevon samples, pH were 6.13 and 6.26 in raw and cooked samples.

Discussion

Recently, usage of medicinal herbs has been increasingly popular in diseases treatment. The screening of *C. colocynthis* seed & fruit extracts antibacterial activities were limited investigated and showed the different efficiency of each part of the plant according to its active compounds contents (Marzouk *et al.,* 2009; Marzouk *et al.,* 2010). The observed MICs (lower than 0.10 mg/ml) considered within acceptable range for the plants and even pure extracts. The antibacterial activity was dependent on the tested strain (for gram negative bacteria, the fruits had the stronger antibacterial activity than the seeds antibacterial effect (Marzouk *et al.,* 2011).

C. colocynthis (seeds, fruit, leaves, stem and root) chemical constituents are; flavonoids, alkaloids, terpenoids, amino acids, carbohydrates. *C. colocynthis* fruits considered the richest source of drugs ingredients including; cucurbitacines, colocynthin, colocynthetin, á-elaterin, cucurbitacins, flavonoids cucurbitacin glycosides, and flavone glycosides (Kapoor *et al.,* 2020).

The reported findings were consistent with those of Dhakad *et al.* (2017) who discovered the stronger effect of the aqueous extract of *C. colocynthis* against *Staphylococcus aureus* and *E. coli* with lesser effect against *Listeria* sp. On the other hand, *C. colocynthis* methanolic extracts viewed better antibacterial effect particullary against; *Staphylococcus aureus, Listeria* sp., and *S. typhi.* Rezaie Keikhaie *et al.* (2018) also

informed that *C. colocynthis* extract has high inhibits potency against *S. aureus* growth.

On the other hand, the fact that most samples were rather resistance at the dosage employed the highest sensitivity was recorded between 10 and 20 mg where 100% of bacteria were eliminated. *C. colocynthis* extract at a dosage of 5 mg/ml had the greatest inhibitory effect. Despite, the 1.25 mg/ml concentration of *C. colocynthis* extract reported the lowest inhibition effect. Nearly same results recorded by Gurudeeban *et al.* (2010) who investigated the antibacterial effect of pure *C. colocynthis* aqueous extracts were detected by agar well diffusion against foodborne pathogens "*Staph. aureus, E. coli*, & *S. typhi* as following; 14±1.25, 13±1.52 and 2±0.42 mm. respectively. In case of methanol extraction of *C. colocynthis* Gurudeeban *et al.* (2010) recorded the following results; " *Staph. aureus, E. coli*, & *S. typhi* as following; 3±0.26, 6±0.25 and 13±0.65 mm. respectively. Different results recorded by Paul and Peter (2008) Ethanol extract showed maximum inhibition against *E. coli* (7mm) and followed by moderate effect against *Staph. aureus* (4mm). There was a least effect on *S. typhi* (1mm). Rose *et al.* (2008) and Ayana *et al.* (2008) examined the antibacterial efficiency of some medicinal plants against *Staph. aureus & E. coli* were recorded the high inhibition zone. More or less similar results were found in the present study. Marzouk *et al.* (2011) reported antibacterial activity of *C. colosynthis* water extract against *Staph. aureus, E. coli, S. typhimurium*, *V. parahaemolyticus* and *L. monocytogenes* as following; 0.200, 0.400, 0.800, 0.400 and 0.400 mm. on the other hand, Marzouk *et al.* (2011) reported antibacterial activity of *C. colosynthis* ethanol extract against *Staph. aureus*, *E. coli, S. typhimurium*, *V. parahaemolyticus* and *L. monocytogenes* as following; 0.003, 0.006, 0.100, 0.050 and 0.050 mm.

According to Gurudeeban *et al.* (2010) and Khatibi and Teymorri, (2011) *C. colocynthis* lophilized aquatic and organic extracts from seeds and fruits were examined for efficiency against Gram-positive (*Staph. aureus, Enterococcus faecalis, Staph. epidermidis, Micrococcus luteus* & *Listeria monocytogenes*) and Gram-negative (*Pseudomonas aeruginosa, V. parahaemolyticus E. coli, S. typhimurium,* & *V. alginolyticus*) in addition to different *Candida* spp. (*Candida albicans, Candida glabrata, Candida kreusei* & *Candida parapsilosis*). Considerably lower activity observed against *Bacillus subtilis* & *Klebseilla pneumonia*. The aquatic extracts didn't exhibit any antimicrobial effect. In case of methanol extracts patent antimicrobial activity recorded against; *Bacillus subtilis, Bacillus cereus, Listeria monocytogenes, Streptococcus pyogenes, Salmonella typhimurium Staphylococcus aureus* and *Shigella sonnei*, lower activity observed against *Streptococcus faecalis,* no effect recorded against *Vibrio cholera, Proteus vulgaris* & *Proteus mirabilis*.

C. colocynthis ethanol extracts reported broad spectrum antibacterial effect against most pathogenic microorganisms including; *Salmonella typhi Streptococcus faecalis, Proteus vulgaris*, *Escherichia coli*, *Proteus mirabilis*, *Bacillus subtilis*, *Klebseilla pneumoniae*, *Staphylococcus aureus, Streptococcus pyogenes,* & *Vibrio cholera*. In addition to 6 fungal strains including; *Aspergillus fumigatus, Rhizopus* sp., *Aspergillus flavus, Candida albicans, Penicillium* sp & *Mucor* sp. The antibacterial effect of different extracts was compared with traditional tetracycline (30 µg/disc), obtained findings suggested that *C. colocynthis* which could be effective in microorganisms' diseases treatment (Gurudeeban *et al.*, 2011).

The antibacterial efficiency of *C. colocynthis* alkaloid extracted were screened against; (*Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Klipsella* sp. & *Streptococcus* sp.) in comparison with two antibiotics (Cephalosporin & Amoxicillin) (Al-hejjaj *et al.*, 2010). *C. colocynthesis* antimicrobial effect examined against some pathogenic microorganisms; *Klebsiella pneumonia, Escherichia. coli, Proteus mirabilis, Streptococcus agalactia, Streptococcus pneumonia, Staphylococcus aureus* & *Streptococcus mutans*. Ethanol and aquatic extracts antibacterial

inhibitory effects of this extracts were compared with standard antibiotics. In case of ethanolic extract the inhibitory effect against; *Proteus mirabilis, Streptococcus agalactia, Escherichia coli* & *Staphylococcus aureus*. The results found that ethanolic extract has the similar inhibitory action with cefotaxime. While, the water extract recorded lower or no any inhibition effect against almost microorganisms (Bnyan *et al.,* 2013).

There is a strong debate about the safety aspects of chemical preservatives which considered hazardous source on consumers health and may causing many teratogenic and carcinogenic hazardous by residual toxicity (Saad *et al.,* 2019). Therefore, the repalcement of these chemicals by safe perservatives one become one of the most demands in food safety technology and perservation technology such as; natuaral perservative including all the natural exctract of different plant parts which have inhibiting effect on one or more of food spoilage and/or food pathogens (Sánchez-Ortega *et al.,* 2014).

The sensory characters of chilled chevon meat along eight days before and after cooking were excellent during first two days of storage, while from 3rd day the quality became very good in all parameters. Almost all parameters remained very good during the 4th day of storage except the odor and consistency which become 'good' in raw chevon samples, during the 5th day of chilling the quality decrease to good in almost parameters except the odor and consistency which become bad in raw chevon samples. Spoilage appeared from the 6th day of storage as all parameters were bad quality except the color of raw meat which was good. The deterioration signs become very clear on the 7th day as all parameters were bad while the odor and consistency of raw samples were very bad in raw chevon samples. The complete spoilage recoded on the 8th day of chilling the chevon samples, pH was 5.85 and 6.6.

Addition of *Citrullus colocynthis* water extract by 1.25%, 5%, 10% and 15% extended the shelf life of chevon from 8 days to 11 days as almost all parameters remain good during the 6th & 7th day of storage. The deterioration signs become very clear on the 11th day as all parameters were very bad in raw chevon samples, pH was 5.85 to 6.35 in raw and cooked samples. While addition of *Citrullus colocynthis* ethanol extract by 1.25%, extended the shelf life of chevon from 8 days to 16 days as almost all parameters remain good during the 10th day of storage. The deterioration signs become very clear on the 16th day as all parameters were very bad in raw chevon samples, pH was 5.85 to 6.51 in raw and cooked samples. While addition of *Citrullus colocynthis* ethanol extract by 5%, extended the shelf life from 8 days to 17 days were worse quality recorded during the 16th & 17th of storage as following; the color and odor of raw samples were very bad while, the color become better after cooking to good quality while the odor not affected by cooking, the consistency not affected by cooking and remain its good quality, the pH ranged from 5.85 – 6.43. on the other hand, addition of *Citrullus colocynthis* ethanol extract by 10% and 15% didn't reported bad significant on the shelf life of the chevon meat from the first day of addition as all physical characters; (Color, Odor, Consistency) were very bad during all days of storage, pH was ranged from 5.85 to 6.43 on raw and cooked samples.

Different types of meat have increased popularity worldwide. The physical food characteristics are the major determinants to the consumers' acceptability toward their different products. However, quality attributes during storage of different food products deteriorate due to bacterial growth and lipid oxidation which are the main factors that determine shelf life reduction and food quality loss, extension of shelf life depending on preserve the physical characters of the food item by addition of either natural or synthetic preservatives (Shaltout *et al.*, 2016).

Conclusion

The obtained findings recorded that the *Citrullus colosynthis* analyzed appeared to a suitable candidate for the development of novel techniques to combat

the foodborne pathogens even at 1.25% concentration, although ethanolic extraction be more effective than water extraction. So, it can be used as a substitute for the traditional formula by the individuals who interest in naturally based products. The very promising results we have obtained provide a rationale for assessing the activity of *C. colocynthis*. Future researches are ongoing to determine and discover the chemical antimicrobial components of the plant extracts.

Recommendation(s)

The very promising results we have obtained provide a rationale for assessing the activity of *C. colocynthis*. Future research is ongoing to determine and discover the chemical antimicrobial components of the plant extracts.

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