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Research Article

Study on the effect of low temperature pasteurization and storage temperature on the microbial dynamics in fresh water prawn

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Abstract: Food security is a complex issue, where fish and fishery products are generally regarded as high risk commodity in respect of pathogen contents, natural toxins and other possible contaminants and adulterants. They are usually sold as a live product and can be stored for several weeks before consumption. Temperature abuse during prawn postharvesting may allow multiplication of natural spoilage flora as well as pathogens, which imparts a potential threat to consumers and / or compromising product quality. So, Present study focused on the effect of low temperature pasteurization (Roasting, boiling at 60°c for 5 min, 10min, 15min) and storage temperature (25°C,4°C,0°C) on the microbial load of raw prawn. The average count of total bacterial count (TBC), E. coli, Vibrio sp., Salmonella sp., total coliforms, fecal coliforms in raw shell stock prawn were cooperatively higher than raw peeled prawn after 15 min boiling and roasting. It also evident that roasting had a more destructive effect on microbes than boiling when applied on both raw peeled samples and shell stock prawn. The effect of storage temperatures on the microbial status were found significantly higher in shell stock prawn than peeled prawn at all the stored temperature and number of the spoilage bacteria were decreased with storage time and also decreased with lowering the temperature for both shell stock prawn and peeled prawn.
Keywords: Prawn, Roasting, Boiling, Storage temperature, Shell-stock prawn, Peeled prawn, Total bacterial count, Total coliform, Fecal coliform.

INTRODUCTION

The order - Decapoda comprises of commercially important species of prawns/shrimps, crabs and lobsters. This order comprises of about 1,100 genera with about 8,321 species, but the figure has been increasing year by year. According to Holthuis, [11], the prawns/shrimps include about 33 genera with about 2,500 species, of which less than 300 species are of economic interest throughout the world. Among the Decapoda crustaceans, penaeids constitute a distinct group of commercially important species. Due to their nutritional value, they support a very valuable, trade export market. Most of these species come under 5 penaeidean families *viz.*, Solenoceridae, Aristidae, Penaeidae, Sicyoniidae and Sergestidae, and three caridian families *viz*,Pandalidae, Crangonidae and Palaemonidae**.** The family Palaemonidae includes two subfamilies, namely Palaemoninae and Pontoniinae. The prawns belonging to the Palaemoninae inhabit inland water bodies, from brackish waters to hill streams, and very rarely marine. Many are large in size and have potential for aquaculture. The Pontoniina includes prawns, which are exclusively marine inhabitant. In the Indian mangrove ecosystems, there are a total of 48 prawn species, of which, 34 (71%) in the mangrove rich east coast, 16 (33%) in the Bay islands and 20 (42%) in the mangrove poor west coast [19, 15]. In the country out of 56 species of shrimp available, only four species, viz. *Penaeus monodon, P. indicus, P. semisulcatus* and *P. merguiensis* have commercial importance and farming facuse on only *Penaeus monodon* (tiger prawn) predominates. The tiger prawns are generally found in East coast and Southwest coast of India. Abundance areas are West Bengal and Orissa coasts. To cite an example, 40,000 fishers get an annual yield of about 540 million seeds of *Penaeus monodon* and 10.26 billion other fish, in the Sundarban mangroves of West Bengal that has dense deltaic mangroves with numerous sheltered water creeks [5]. In Bangladesh, the fish/shrimp catch records of twelve years (1972 - 1983) reveal an average annual production of 7,163 metric tons [7]. Recently Chantarasri [3] reported that > 10,000 tons of shrimps, fishes and crabs were harvested from the Sundarban ecosystem in the year 1993[. About 334 million tiger

shrimp fries were also collected by about 110,000 fishermen [3] from the mangrove ecosystem. The mangrove ecosystem of Tutoia, Maranhao, near the Piacci border (Brazil) supports 1,800 mostly artisanal fishermen, who caught 1,162 tons of penaeid shrimp in 1977 [20] and in Baia de Sepetiba, Rio de Janeiro, where 3,200 ha of mangroves yield between 100 and 200 tons of shrimps annually [16]. The composition of nutrients in 100g of edible product of prawn are Moisture (79g), Protein (18g), Lipid (0.9) Glucid (0.9), Calcium (79mg), Phosphor (184mg), Iron (1.6mg), Vitamin A (20mg), B1 (0.1mg), B2 (0.1mg) and PP (2.3mg). The main processed shrimp species are generally giant tiger prawn, Indian white prawn, banana prawn, *Parapenaeopsis*, etc. and the products are whole frozen, frozen preliminary processed, ready processed (value added and mixed processed) and canned.

There have been several reports on the health risks associated with the consumption of seafood, ranging from allergic reactions, stomach and intestinal cancerous growths, a general degeneration of peripheral cellular tissues, to gradual breakdown of the digestive and excretive systems in a statistically high percentage of people [6]. According to Higgins [10], standards of sanitation, method of handling and the time/temperature of holding fish are all crucial element to assure quality. Moreover, estimation of bacterial numbers in fish is frequently used to assess microbiological quality or to assess the presumptive safety of the product. When total count reaches 10 CFU (Colony Forming Units) per gram or milliliter of product [12], the product is assumed to be at, or nearing, spoilage. In raw shrimp, acceptable component limit of fecal coliforms less than 20 CFU/g, *Staphylococcus aureus* i.e. coccal enterotoxin level equal to or greater than 104 CFU/g, *Salmonella* sp. presence of organism [9]. So, present study focused on the use of low temperature pasteurization and storage temperature to reduce the microbial load to non- detectable.

MATERIALS AND METHODS

Sampling

Fifteen prawn samples (prawn sample: 100g) were collected from local market (Panskura, West Bengal). Each prawn was scrubbed, rinsed with distilled water (four times) and stored in a container, preserved in crystal ice and brought to the laboratory immediately.

Preparation of samples

Each prawn sample (100g) was divided into three equal parts under aseptic conditions. Five prawn samples were used in each experiment. The external skeleton was removed and immediately used for the microbial analysis of prawn flesh [1]. The whole shell-stock as well as raw peeled prawn were stored at three temperatures (viz., at 0°C, 4°C and 25°C) for up to 21 days. On a separate study, shell-stock and peeled prawn were separately roasted and submerged in hot water (~60°C) for 0, 5, 10 and 15 min [2].

Microbial analysis

In this experiment, for total aerobic heterotrophic bacteria, coliforms, fecal coliforms (FCs), *E.coli*, *Vibrio* sp. and *Salmonella* sp. were quantified before and after storage at different temperatures.

For bacterial analysis, 10 g prawn tissue (meat) was blended with 90 ml of sterile 0.5% (w/v) peptone buffer (pH –7.0) and different dilutions (10^{-1} to 10^{-2}) were prepared. For quantification of coliform and FC, the standard MPN (Most Probable Number) procedure was adopted using LTB (lowryl tryptose broth) and EC (*Escherichia coli*) culture broth, respectively [4]. Briefly, 10 ml of 10^{-1} tissue dilution was added in test tube containing 10 ml volume of double strength media and 1ml of each homogenate (10^{-1} and 10^{-2} dilution) was added separately in test tube containing 10 ml volume of single strength LTB broth with inverted Durham's tubes. The total sets were incubated at 35 ± 0.5°C for 24 hrs and examined for the presence of growth accompanied by gas (CO_2) production that will be visible as a bubble in the inverted tubes. Cultures that are not capable of fermenting a carbohydrate substrate, there will not be a concomitant evolution of gas. This is a negative reaction. The density of bacteria was calculated on the basis of positive and negative combination of the tubes. The MPN was calculated and results were expressed as 'presumptive coliform MPN/100 g'. Then the positive cultures were inoculated into brilliant green lactose bile broth and the tubes were incubated at 35 ± 0.5°C for 24 hrs and examined for growth with gas production. The MPN of total coliform (TC) was calculated and results were expressed as 'confirmed coliform MPN/100 g'. To quantify the FC, inoculum from 24 hrs positive presumptive tubes were aseptically transferred to tubes of EC medium. These tubes were incubated at 44.0 ± 0.5°C for 24 hrs and examined for the presence of growth with gas production. Results were expressed as 'FC MPN/100 g'. The quantification of total bacteria (TBC), *E.coli*, *Vibrio* sp. and *Salmonella* sp. in all prawn samples was done by standard plate counting method using tryptose glucose beef extract agar (TGBEA), EMB agar, thiosulfate-citrate-bile-salt agar and Selenite Cystine agar media, respectively[13,14].

RESULTS AND DISCUSSION

Effect of roasting and boiling on the microbial of shell stock prawn and peeled prawn

Effect of roasting

The average result of the experiments revealed that the total bacterial count (TBC), *E.coli*, *Vibrio* sp, *Salmonella* sp. total coliform and fecal coliform count were 8.6×10^6 cfu/g, 2.4×10^3 cfu/g,, 5.5×10^2 cfu/g, 3×10^2 cfu/g, 110 MPN/g and 4.5MPN/g organisms respectively in raw sample which is higher than the recommended value of EU norms. These count were significantly reduced to 3×10^3cfu/g for TBC, non-detectable for *E.coli*, *Vibrio* sp. *Salmonella* sp. and <3MPN/g for coliform, non-detectable for fecal

coliform after 15 minutes roasting of prawn in shell condition. While, in roasted peeled parts, all counts were sharply reduced and reached to 1.2×10^3cfu/g for total bacterial count and non-detectable for *E.coli*, *Vibrio* sp. *Salmonella* sp. coliform and fecal coliform (Table 1).

Table 1: Effect of roasting (60°C) on microbial load of shell-stock prawn and peeled prawn

Microbial parameter	Shell stock prawn				Peeled prawn			
Boiling duration	0min	5min	10min	15min	0min	5min	10min	15min
TBC(10^6cfu/g)	8.6	0.05	0.045	0.003	8.4	0.038	0.036	0.0012
E.coli(10^3cfu/g)	2.6	2.1	0.13	0	2.2	0.07	0	0
Vibrio sp. (10^2cfu/g)	7	1.8	0.2	0	4	1	0	0
Salmonella sp. (10^2cfu/g)	4	1.5	0.1	0	2	0.1	0	0
Total coliform(MPN/g)	110.0	2.0	0.9	0.4	15.0	0.9	0.4	0
Fecal coliform(MPN/g)	4.5	0.7	0	0	7.5	0.7	0	0

Effect of boiling

The average result of the experiments revealed that the total bacterial count (TBC), *E.coli*, *Vibrio* sp. *Salmonella* sp. total coliform & fecal coliform count were 9.5×10^6 cfu/g, 2.5×10^3 cfu/g,, 7.5×10^2 cfu/g, 4×10^2 cfu/g,140 MPN/g, and 15 MPN/g organisms respectively in raw samples. These counts were significantly reduced to 3×10^3 cfu/g for TBC, non-detectable for *E.coli*, *Vibrio sp.*, *Salmonella* sp. and 7.5MPN/g for coliform, non-detectable for fecal coliform after 15 minutes boiling of prawn in shell condition. While, in boiled peeled parts, all counts were sharply reduced and reached to 1.3×10^3cfu/g for total bacterial count and non-detectable for *E.Coli*, *vibrio* sp, *Salmonella* sp., 3.5MPN/g for coliform and non-detectable for fecal coliform (Table 2).

Table 2 : Effect of boiling (60°C) on the microbial load of shell-stock prawn and peeled prawn

Microbial parameter	Shell stock prawn				Peeled prawn			
Boiling duration	0 min	5 min	10 min	15 min	0 min	5 min	10 min	15 min
TBC (10^6 cfu/g)	10	0.07	0.04	0.003	9.1	0.48	0.035	0.001
E.coli(10^3cfu/g)	2.7	2.2	0.15	0	2.3	2.1	0.13	0
Vibrio sp. (10^2cfu/gm)	9	2	0.3	0	6	2	0.1	0
Salmonella Sp. (10^2 cfu/g)	5	2.2	0.2	0	3	0.2	0	0
Total coliform(MPN/g)	140	140	9.5	7.5	110.0	30	3.5	0
Fecal coliform(MPN/g)	15	20	0.4	0	11.5	3.0	0	0

The heat treatment was very effective in the reduction of microbial load in the prawn. The present study revealed that the heat treatment method (roasting and boiling) was more significant for the reduction of bacterial load in peeled parts than those in shell and this could be mainly attributed to the protection of muscles by the shell cover. The result also indicated that roasting is more effective than boiling. Therefore, roasting proved its efficacy in reducing bacterial load of prawn and this agrees with the finding reported by Ridly and Siabyj, [18].

Effect of freezing on microbial load of fresh shell stock and peeled prawn

Mean levels of all studied microorganism was decreased in both shell-stock and peeled prawn after seven days of storing at all levels of exposed temperature, i.e., 4°C and 0°C except 25°C (Tables 3 - 4). After 14 days storage these average counts were reduced to non- detectable organisms (in both prawn) except total bacterial count and total coliform (Tables 3 - 4).

Table 3: Effect of freezing on microbial load of fresh shell stock prawn

Microbial parameter	37°C	25°C			4°C			0°C		
Storage duration	Control	7 days	14 days	21 days	7 days	14 days	21 days	7 days	14 days	21 days
TBC (10^6cfu/g)	8.3	8.5	Spoil	Spoil	4.5	0.38	0.032	0.33	0.028	0.0021
E.coli(10^3cfu/g)	2.5	2.8	Spoil	Spoil	0.07	0	0	0.06	0	0
Vibrio sp. (10^2cfu/g)	7.0	8	Spoil	Spoil	0.06	0	0	0.05	0	0
*Salmonella sp. (10^2*cfu/g)	5.0	6	Spoil	Spoil	0.05	0	0	0.04	0	0
Total coliform(MPN/g)	140	140	Spoil	Spoil	45	16	3	45	15	3.0
Fecal coliform(MPN/g)	20	20	Spoil	Spoil	0	0	0	0	0	0

Table 4: Effect of freezing on microbial load of fresh peeled prawn

Microbial parameter	37°C	25°C			4°C			0°C		
Storage duration	Control	7days	14days	21days	7days	14days	21days	7days	14days	21days
TBC (10^6cfu/g)	6.5	7.8	Spoil	Spoil	4	0.35	0.03	0.32	0.027	0.002
E.coli(10^3cfu/g)	2.3	2.6	Spoil	Spoil	0.05	0	0	0.04	0	0
Vibrio sp. (10^2cfu/g)	6.5	7.0	Spoil	Spoil	0.05	0	0	0.03	0	0
Salmonella sp. (10^{2}cfu/g)	4.3	5.5	Spoil	Spoil	0.03	0	0	0.02	0	0
Total coliform(MPN/g)	110	140	Spoil	Spoil	20.0	6.5	1.5	9.5	2.0	0
Fecal coliform(MPN/g)	11	20	Spoil	Spoil	0	0	0	0	0	0

Effect of freezing on the microbial community in shell stock and peeled prawn after boiling and roasting

The effect of storing temperatures on the quantity of studied microbes in shell stocks and peeled prawn after boiling and roasting were represented in (Table 5 - 8). Present result showed that after boiling and roasting, the total bacterial count (TBC), *E.coli*, *Vibrio* sp. *Salmonella* sp. total coliform & fecal coliform count were increased at 25ºC with increase the storage time but decreased at 4ºC and 0ºC after 7, 14 and 21 days for all shell stock and peeled prawn . The concentration of all the studied microbial groups is decreases with decrease the storage temperature (Table 5- 8).

The occurrence or growth of all the studied microbial groups was much higher in shell stock prawn than peeled prawn at all levels of exposed temperature, i.e., at 4°C , 0°C and 25°C. This is because outer shell of prawn may protect the microorganism from cold shock. Moreover, all the microbial loads are gradually decreases with increase the storage time. This may be due to sub lethally injury bacterial cells by frozen storage. These findings agree with the investigator as Fieger and Dubois, [8, 17]. Frozen storage of prawn frequently causes reduction in bacterial population. Present result also showed that the microbial load abnormally decreases if the peeled prawn is store after roasting by 21days. Therefore, it was recommended that good sanitary practice (roasting) maintenance the bacteriological standard for the quality of the prawn.

Table-5: Effect of storage (for7days) after boiling (60°C) on microbial load of shell-stock prawn

Microbial parameter	25°C			4°C			0°C		
	5min	10min	15min	5min	10min	15min	5min	10min	15min
TBC (10^6cfu/g)	8.3	0.79	0.076	7.3	0.7	0.048	0.065	0.058	0.004
E.coli(10^3cfu/g)	3	2.3	0.2	2	0.13	0	1.9	0.10	0
Vibrio sp. (10^2cfu/g)	7	6	3	0.03	0	0	0.03	0	0
Salmonella sp. (10^{2}cfu/g)	2.9	2.5	2.3	0.05	0	0	0.04	0	0
Total coliform(MPN/g)	110.0	16.8	15.0	6.5	4.0	3.5	3.5	2.0	0.9
Fecal coliform(MPN/g)	3.5	3.0	3.0	1.4	1.5	0	3.0	1.5	0
	after 14 days								
TBC (10^6cfu/gm)	8.8	0.87	0.084	5.7	0.39	0.027	0.055	0.032	0.001
E.coli(10^3cfu/g)	3.5	2.9	0.25	1.9	0.12	0	1.8	0.12	0
Vibrio sp. (10^2cfu/g)	7	6	4	0.02	0	0	0.01	0	0
Salmonella Sp.(10^{2}cfu/g)	3	2.9	2.7	0.04	0	0	0.03	0	0
Total coliform(MPN/g)	140.0	140.0	110.0	2.0	2.0	2.0	0.4	0.3	0
Fecal coliform(MPN/g)	15.0	7.5	2.0	1.4	0	0.7	0.4	0	0
	after 21days								
TBC (10^6cfu/gm)	8.9	0.88	0.082	5	0.38	0.025	0.049	0.031	0.001
E.coli(10^3cfu/g)	3.6	0.35	0.28	1.7	0.11	0	1.6	0	0
Vibrio sp.(10^2cfu/g)	7	7	5	0.01	0	0	0.01	0	0
Salmonella Sp.(10^{2}cfu/g)	4	2.7	2.6	0.03	0	0	0.02	0	0
Total coliform(MPN/g)	140.0	110.0	140.0	2.0	1.5	0.7	0	0	0
Fecal coliform(MPN/g)	3.0	2.0	3.0	0.7	0.4	0	0	0	0

Table 6: Effect of storage (for 7 days) after boiling (60°C) on microbial load of peeled prawn

Microbial Parameter	25°			4°C			0°C		
	5min.	10min.	15min	5min	10min	15min	5min.	10min.	15min
TBC (10^6cfu/g)	8	0.73	0.07	5.6	0.44	0.03	5.3	0.34	0.014
E.coli(10^3cfu/g)	2.8	2.1	0.19	1.4	0.11	0	1.2	0.1	0
Vibrio sp. (10^2cfu/g)	6	5	4	0.02	0	0	0.02	0	0
Salmonella sp.(10^2cfu/g)	2.5	2.1	2.0	0.04	0	0	0.03	0	0
Total coliform(MPN/g)	15.0	3.5	2.0	2.0	2.0	1.1	1.1	0.7	0.6
Fecal coliform(MPN/g)	2.0	2.0	2.0	1.4	0.7	0	0.7	0.3	0
	after 14 days								
TBC (10^6cfu/gm)	8.2	0.75	0.08	3.9	0.28	0.021	4.4	0.32	0.013
E.coli(10^3cfu/g)	2.8	2.2	0.2	1.3	0.09	0	1.2	0.07	0
Vibrio sp.(10^2cfu/g)	7	5.5	4.5	0.01	0	0	0	0	0
Salmonella Sp.(10^2cfu/g)	2.6	2.2	2.2	0.02	0	0	0	0	0
Total coliform(MPN/g)	110.	4.0	3.0	0.9	0.7	0.4	0	0	0
Fecal coliform(MPN/g)	3.0	3.0	1.5	0.4	0.3	0	0	0	0
	after 21 days								
TBC (10^6cfu/gm)	8.3	0.76	0.09	3.5	0.18	0.011	2.6	0.1	0.001
E.coli(10^3cfu/g)	2.7	2.4	0.21	1.2	0.04	0	1	0	0
Total *Vibrio sp.*(10^2cfu/g)	7	5.6	4.8	0	0	0	0	0	0
Total *Salmonella Sp.*(10^2cfu/g)	2.6	2.3	2.3	0	0	0	0	0	0
Total coliform(MPN/g)	4.0	4.0	45.0	0.3	0	0	0	0	0
Fecal coliform(MPN/g)	3.0	2.0	1.5	0	0	0	0	0	0

Table 7: Effect of storage (for 7 days) after roasting (60°C) on microbial load of shell-stock prawn

Microbial Parameter	25°C			4°C			0°C		
	5min	10min	15min	5min	10min	15min	5min	10min	15min
TBC (10^6cfu/g)	7.8	0.75	0.072	5.8	0.49	0.036	0.049	0.032	0.002
E.coli(10^3cfu/g)	2	2.1	0.19	2	0.1	0	0.1	0	0
Vibrio sp.(10^2cfu/g)	6	5	3	0.02	0	0	0.02	0	0
Salmonella Sp.(10^2cfu/g)	2.7	2.4	2.2	0.04	0	0	0.03	0	0
Total coliform(MPN/g)	110.0	20.0	15.0	3.0	1.5	0.7	1.6	1.5	0.7
Fecal coliform(MPN/g)	9.5	7.5	7.5	1.7	0	0	1.1	0	0
	after 14 days								
TBC (10^6cfu/gm)	7.9	0.76	0.074	5.5	0.48	0.035	0.048	0.031	0.001
E.coli(10^3cfu/g)	2.1	2.2	0.18	0.09	0	0	0.07	0	0
Vibrio sp.(10^2cfu/g)	6.1	5.7	3.2	0.01	0	0	0	0	0
Salmonella Sp.(10^2cfu/g)	2.7	2.5	2.3	0.03	0	0	0.02	0	0
Total coliform(MPN/g)	140.0	110.0	110.0	0.9	0.4	0	0.7	0.4	0.4
Fecal coliform(MPN/g)	45.0	25.0	25.0	0.4	0	0	0.7	0	0
	after 21 days								
TBC (10^6cfu/gm)	7.9	0.75	0.075	4.5	0.49	0.039	0.047	0.03	0.001
E.coli(10^3cfu/g)	2.2	2.3	0.19	0.07	0	0	0.05	0	0
Vibrio sp.(10^2cfu/g)	6.3	5.8	3.3	0	0	0	0	0	0
Salmonella Sp.(10^2cfu/g)	2.8	2.6	2.4	0.02	0	0	0.01	0	0
Total coliform(MPN/g)	110.0	110.0	110.0	0.4	0	0	0	0	0
Fecal coliform(MPN/g)	25	25	30	0	0	0	0	0	0

Table 8: Effect of storage (for 7 days) after roasting (60°C) on microbial load of peeled prawn

Microbial Parameter	22°			4°C			0°C		
	5min	10min	15min	5min	10min	15min	5min	10min	15min
TBC (10^6cfu/g)	7.3	0.72	0.071	3.7	0.29	0.014	2.3	0.22	0.019
E.coli(10^3cfu/g)	1.9	1.8	0.17	0.07	0	0	0.05	0	0
Vibrio sp.(10^2cfu/g)	5	4	2	0.01	0	0	0	0	0
Salmonella Sp.(10^2cfu/g)	2.6	2.3	2.1	0.02	0	0	0	0	0
Total coliform(MPN/g)	110.0	45.0	25.0	2.0	1.4	0.7	1.5	1.1	0.6
Fecal coliform(MPN/g)	20.0	16.0	11.5	1.4	0	0	0.9	0	0
	after 14 days								
TBC (10^6cfu/g)	7.4	0.78	0.077	3.7	0.28	0.013	2.1	0.021	0.018
E.coli(10^3cfu/g)	2.1	1.9	0.17	0.06	0	0	0.03	0	0
Vibrio sp.(10^2cfu/g)	5.2	4.3	2.3	0	0	0	0	0	0
Salmonella Sp.(10^2cfu/g)	2.6	2.2	2.1	0	0	0	0	0	0
Total coliform(MPN/g)	140.0	110.0	110.0	0.7	0.3	0	0.3	0	0
Fecal coliform(MPN/g)	30	25	25	0.6	0	0	0	0	0
	after 21 days								
TBC (10^6cfu/gm)	7.5	0.79	0.078	3.5	0.18	0.012	2.1	0.01	0.001
E.coli(10^3cfu/g)	2.2	2.0	0.18	0.02	0	0	0.01	0	0
Vibrio sp.(10^2cfu/g)	5.5	4.8	2.7	0	0	0	0	0	0
Salmonella Sp.(10^2 cfu/g)	2.6	2.5	2.3	0	0	0	0	0	0
Total coliform(MPN/g)	140.0	110.0	110.0	0.3	0	0	0	0	0
Fecal coliform(MPN/g)	30	25	20	0	0	0	0	0	0

CONCLUSION

The effect of low temperature pasteurization (roasting, 60°C for 15 min) was very effective in reducing the pathogen to non detectable levels. Proximate analysis also revealed that roasting is more acceptable method for prawn to reduce the microbial load up to permissible level as per EU norms.

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