JOURNAL OF CULINARY SCIENCE & TECHNOLOGY
https://doi.org/10.1080/15428052.2020.1840474

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Comparative Studies on the Chemical Composition of Inland Saline Reared *Litopenaeus vannamei*

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ABSTRACT

A comparative study of chemical composition between the muscles of *Litopenaeus vannamei* reared in inland saline water (ISRV) and brackish water (BWRV) was taken up. Slightly higher water content, pH, nonprotein nitrogen fractions were observed in ISRV. Some amino acids like glutamic acid, aspartic acid, arginine, lysine and glycine contents were higher in BWRV. On the contrary, ISRV meat had higher hydroxyproline, alanine and leucine content. The polyunsaturated fatty acid content of BWRV and ISRV samples were 41.67% and 46.50%, respectively. Potassium was the dominant mineral in both BWRV and ISRV shrimp meats, i.e., 1011 and 836.3 mg/100 g of meat, respectively. The proportion of composition varied with both the shrimp sample. Though the composition was varied most of the amino acids, fatty acids and minerals were comparable to one another. Therefore, it can be concluded that the overall meat quality of ISRV shrimp is not affected.

ARTICLE HISTORY
Received 8 June 2020
Revised 13 August 2020
Accepted 18 October 2020

KEYWORDS
Inland saline water; *Litopenaeus vannamei*; amino acids; fatty acids; mineral profiling

Introduction

Inland saline aquaculture is stated as land-based aquaculture utilizing saline groundwater. Salinization of soils and groundwater is a global issue which makes an estimate of 380 million ha area of land unusable for agriculture (Lambers, 2003). In India, 40% of salt-affected land is concentrated in the north-western, semi-arid/arid states of Haryana, Punjab, Uttar Pradesh and Rajasthan which accounts for approximately 8.7 million ha of the total land (Allan, Fielder, Fitzsimmons, Applebaum, & Raizada, 2009). Salt-affected soils are an essential ecological entity in the landscape of any arid and semi-arid region. Utilization of saline groundwater for aquaculture production in India has been identified as a high-priority research area in order to utilize the available resources which cannot be used for agriculture purpose due to salinity, specifically aimed to educate farmers toward developed technology (Singh, Jahan, Sharma, & Misra, 2014). Saline groundwater is one of the most potential resources for increasing aquaculture production in India and many

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countries like the USA, China, Vietnam, Thailand, etc. Recently rearing of shrimp in inland-saline water is a flourishing industry around the globe (Flaherty, Szuster, & Miller, 2000; Roy et al., 2010).

Seafood products are considered as an important source of nutrition in the human diet. Crustacean seafood species like shrimp, crab and lobster in addition to their delicacy also contains a rich reserve of amino acids, protein, peptides and other valuable nutrients (Sriket, Benjakul, Visessanguan, & Kijroongrojana, 2007). *Litopenaeus vannamei* constitutes an important aquaculture species having extensive market value around the globe representing more than 90% of production (Senapati et al., 2017). It has established itself in becoming a widespread species in Indian shrimp farming in the current years. Since its inception to India in the year 2009, farming of this exotic species at a commercial level has gained tremendous momentum owing to its rapid growth rate, lower dietary protein requirement and tolerance toward high stocking density and wide ranges of salinity and temperature conditions. (Lakra, Reddy, & Harikrishna, 2014). There has been an increase in the export of this shrimp from 3,29,766 MT to 4,02,374 in 2017–18 with an improvement of 22.02%. In terms of value, *L. vannamei* shrimp was exported to the USA at a rate of 52.84% of total produce, followed by South-East Asian countries (21.03%), EU (11.31%), Japan (4.67%), Middle East (3.00%), China (1.35%) and other countries (5.80%) as per MPEDA (2018). Presently, *L. vannamei* is being grown at commercial as well as experimental levels in inland saline waters in different states of the USA (Samocha et al., 2002) and India (Lakra et al., 2014).

The freshness of shrimp is an important factor that determines its commercial value and potential for export. Several models are used to predict the quality parameters of shrimp (Ahmad & Jeenanunta, 2015; Ahmad, Jeenanunta, Chanvarasuth, & Komolavanij, 2014). Shrimp consists of high-quality protein and certain minerals such as sodium, potassium, calcium, phosphorous, magnesium and also has a rich reserve of extractable compounds essential to the human body but has a lower fat content (Oksuz, Ozyilmaz, Aktas, Gercek, & Motte, 2009). Despite being lower in fat the proportion of polyunsaturated fatty acids (PUFA) like eicosapentaenoic (20:5n3, EPA) and docosahexaenoic (22:6n3, DHA) acids are higher in shrimps (González-Félix, Gatlin, Lawrence, & Perez-Velazquez, 2002) though the composition of this fatty acid varies with stocking density, feed, feed quality and water quality parameters (Cruz-Suárez, Ricque-Marie, Martínez-Vega, & Wesche-Ebeling, 1993; Sriket et al., 2007).

Saline and sodic soils are widespread in inland areas and are progressively expanding because of improper water management. Inland saline water differs from location to location in terms of both salinity and ionic composition. The salinity in the inland saline zone is varying from >0.5 to 165 ppt. The salinity of the inland saline water ranges from 10 to 25 ppt and pH 8.5 with a high level of

Ca2+ and Mg2+, which has resulted in high water hardness (Jana, Garg, & Patra, 2004; Singh et al., 2014). When the shrimps cultured away from its natural rearing condition, i.e., inland saline water, there is a chance that they are biologically stressed which might be lead to a change in chemical composition. So far, we have not come across any report on the amino acid, fatty acid and mineral composition of *L. vannamei* grown in inland saline water. Therefore this work was carried out to compare the mineral, amino acid and fatty acid composition of *L. vannamei* cultured in inland saline water in comparison to those reared in brackish water.

Materials and methods

Raw materials

Freshly harvested Pacific white shrimp (*L. vannamei*) reared from brackish water with a salinity of 24 parts per thousand (ppt) were collected from the Valsad district of Gujarat, India. Shrimp was immediately iced in plastic polystyrene-insulated container with 1:1 shrimp: ice ratio (w/w) and brought within 4 hours from Valsad to the laboratory. Freshly harvested Pacific white shrimp (*L.vannamei*) reared in inland saline water with the salinity range of 14 ppt were collected from the Rohtak district of Haryana, India and transported by air to the laboratory of Post-Harvest Technology, CIFE, Mumbai within 5 hours. The average count of both the shrimp from Rohtak and Valsad was 40–50/kg, respectively.

Proximate composition

The proximate composition of the sample was determined by AOAC (2005) methods. The moisture content of the sample was estimated by a hot air oven. Preweighed wet sample was kept in a hot air oven maintained at 100 ± 2°C to dry for 16–18 hours. After drying, the weights of the samples were taken and moisture content was calculated. A dried sample was used for further proximate analysis. Nitrogen content was analyzed using the Kjeldahl nitrogen analyzer (Kelplus-KES12L VAI, Pelican, India). Crude protein content was calculated by multiplying the nitrogen value with the conversion factor (N × 6.25). The crude fat content was determined using the Soxhlet method and ash content was determined by charring and incinerating the sample at a temperature around 600°C in a muffle furnace (EXPO HI-TECH, i-therm AL-7941, Mumbai, India) for 6 h. Final values obtained were converted into a wet weight basis.

Determination of pH and NPN

About 10 g shrimp muscle was added up with 50 mL distilled water in a homogenizer (Polytron system PT 2100, Germany) for 30 sec and the pH value of shrimp homogenate was determined using a digital pH meter (Eutech tutor pH/°C meter, Eutech Instruments, Singapore) standardized with buffers of pH 4 and 7. NPN content was measured by AOAC (2005) methods.

Amino acid profile analysis

Samples (100 mg) were hydrolyzed in 10 mL 6 N HCl in sealed vacuum tubes at 110°C for 24 h. After hydrolysis, the 6 N HCl was evaporated and a residue of 200 µL was retained. From this 5 µL is taken and diluted with 500 µL of distilled water. Hi P sampler (G4226A) with draw and eject speed of 100 µL min^{-1} with an injection volume 20 µL was used. The flow rate at a rate of 1.5 mL min^{-1} was maintained with a high-pressure limit of 1200 bar using a binary pump (G4220B, Agilent Technologies, Santa Clara, CA, USA). Amino acids were analyzed by using HR-LCMS as per the method described by Pattanaik et al. (2020).

Fatty acid profile analysis

About 10 g of shrimp muscle was macerated with 60 ml of chloroform: methanol (2:1) solution in a mortar. Homogenized sample was filtered through Whatman No. 1 filter paper into a separating funnel. After 10 minutes, 5 ml of salt solution was added and thoroughly mixed. Then the sample was kept undisturbed overnight for separation. Lower lipid layer obtained after separation was collected in a round bottom flask and made to evaporate in a rotary vacuum evaporator at 55°C till dryness. Dried lipid kept was further analyzed (Folch, Lees, & Stanley, 1957). The lipid extract obtained was boiled in a round bottom flask connected to a condenser with 2 ml methanolic NaOH for about 5 minutes and further with 2 ml BF_3-methanol for the next 2 minutes. 5 ml n-heptane was added and heated continuously for further 8 minutes to recover the fatty acid methyl ester (FAME) in the organic phase. This was washed into a separating funnel with a saturated NaCl solution and the upper FAME layer was collected and stored in glass vials at −20°C for further analysis in GC-MS (AOAC, 1995). GC-MS (QP2010, Shimadzu, U.S.A.) equipped with DB Wax (30 m × 0.25 mm internal diameter × 0.25 µm film thickness) capillary column (Cromlab S. A.) was used to separate the methylated fatty acids. Helium was used as a Carrier gas. Temperatures for the Injector and detector was 250°C. Injection volume of 1 µl FAME was taken and the injection was performed in split mode (1:15). The initial column temperature was maintained at 50°C for 2 minutes. The temperature was set to increase at

the rate of 10°C per minute until the final temperature of 230°C reached and to maintain that temperature for about 35 minutes. FAME was separated at a constant pressure of 82.5 KPa. The peaks were identified by comparing the mass spectra with the mass spectral database.

Mineral profile analysis

Mineral contents were quantified by the inductively coupled plasma optical emission spectrophotometer, ICP-AES (Model Thermo Electron IRIS INTREPID II XSP DUO, Germany). The dried shrimp sample was homogenized with concentrated HNO_3. The homogenate was digested using a Microwave Digester (Milestone, Shelton, Italy) and the prepared sample was aspirated into the flame and the corresponding absorption of the characteristic radiation by each element was recorded. The mineral concentration was calculated and expressed as mg/100 g sample.

Statistical analysis

Statistical package of SPSS 16.0 (SPSS, 2000) was used for analyzing the experimental results. Duncan's multiple range test was used for Post hoc comparison to assess statistical significance ($p<.05$) between the treatments and the results were expressed as mean ± standard deviation.

Results and discussion

Proximate analysis of freshly harvested L. vannamei

Table 1 represents the proximate composition of freshly harvested *L. vannamei* from brackish water and inland saline water. The moisture, protein fat and ash content of BWRV and ISRV samples were 76.04%, 20.91%, 0.82%, 1.27% and 78.84%, 17.98%, 0.81%, 1.28%, respectively. Changes in the values of proximate composition in shrimp meats are affected by factors like species, size, gender, age, growth stage, feed, nutrition,

Table 1. Proximate composition, pH and nonprotein nitrogen of freshly harvested *L. vannamei* (wet weight basis).

Parameters	BWRV	ISRV
Moisture (g/100 g)	76.04 ± 0.67^a	78.84 ± 1.34^b
Crude protein (g/100 g)	20.91 ± 0.94^a	17.98 ± 2.14^b
Fat (g/100 g)	0.82 ± 0.41^a	0.81 ± 0.01^a
Ash (g/100 g)	1.27 ± 0.14^a	1.28 ± 0.09^a
pH	6.14 ± 0.02^a	6.65 ± 0.04^b
NPN (g/100 g)	0.18 ± 0.00^a	0.39 ± 0.00^b

BWRV- Brackish water reared *vannamei*, ISRV-Inland saline reared *vannamei*
Data are expressed as the mean± SD (n = 3), the mean value in the same row with different superscripts are significantly different ($p < 0.05$).

environment and season (Farajzadeh, Motamedzadegan, Shahidi, & Hamzeh, 2016; Sriket et al., 2007). From the results, the significantly higher ($p < .05$) moisture content (78.84%) was observed in ISRV than the BWRV (76.04%). The protein content was observed significantly higher ($p < .05$) in BWRV sample (20.91) than ISRV (17.98%). The variation in the moisture and protein content could be due to the minor variation of time in ice after harvesting. There was no significant difference ($p > .05$) observed in the fat and ash content of both BWRV and ISRV samples. The proximate composition of shrimps reared in both the conditions was similar to the findings of Farajzadeh et al. (2016). The moisture, protein, fat and ash contents of the regularly farmed *vannamei* were 77%, 19.9%, 0.96% and 1.4%, respectively (Farajzadeh et al., 2016). However, Senapati et al. (2017) reported higher protein and lesser moisture content of regularly farmed *vannamei* which was slightly different from the present results. The moisture, protein, fat and ash content of the shrimp in the present study were correlating with the chemical composition of *vannamei* cultured in seawater and low salinity water (Liang, Wang, Wang, Chang, & Mai, 2008). The moisture content was found significantly lower (74.72%) in the seawater shrimp than that of low salinity water (80.78%) whereas the protein content was lower (18.00%) than the shrimp from the seawater (22.48%). The fat and ash content of both the samples did not show any significant difference. Consequently, the obtained results were in accordance with the report of Liang et al. (2008)

pH and NPN content of freshly harvested L. vannamei

pH is one of the most frequently used physical parameter for determining the quality of seafood products. Changes in the concentrations of free hydrogen and hydroxyl ions due to the shifts in the oxidation–reduction balance of the food by the enzymic and microbial activity affect the pH values (Condurso et al., 2016). From the results, the pH value of the BWRV sample was 6.14 and ISRV sample was 6.65. pH is an indicator of acidity which is related to the microbial growth in the samples (Imran, Chawalit, & Somrote, 2013). The pH range of the ISRV sample is in agreement with the previous observation of (Bhat, Chouksey, Balange, & Nayak, 2018) where they found the initial pH of shrimp (*L. vannamei*) was 6.70. The pH value of fresh *Litopenaeus vannamei* was 6.70 (Senapati et al., 2017). Annamalai et al. (2015) reported an initial pH of 6.8 in white shrimp meat. However Mu, Chen, Fang, Mao, and Gao (2012) reported the pH value of fresh regularly farmed *L. vannamei* was 7.04.

Sarcoplasm of the muscle constitutes mainly of nonprotein nitrogen fraction which includes amino acids, amines, ammonia, peptides, amine oxides, guanidine compounds, quaternary compounds, purine and urea. This nonprotein nitrogen contributes significantly to the unique seafood taste as well as to its spoilage (Ginson & Bindu, 2017). From the results, the NPN value of the

BWRV sample is 0.18% and the ISRV sample is 0.39%. The higher NPN of the ISRV sample was showed a good correlation with the pH value of the ISRV sample. The NPN content of the ISRV sample was correlating with the finding of Akintola and Bakare (2010). The NPN content of the *Macrobrachium vollenhovenii* was 0.41%. Annamalai et al. (2015) reported slightly higher NPN content (0.72%) in *vannamei* than the present study. A similar result of NPN (0.72%) was found by Bhat et al. (2018) in *L.vannamei* shrimp.

Amino acid composition of freshly harvested L. vannamei

Amino acids are building blocks of proteins. Free amino acid content in the muscle influences the characteristic flavor of fish and shellfish and plays an excellent role for osmoregulation in crustaceans (Ginson & Bindu, 2017). The amino acid profiles of freshly harvested *L. vannamei* reared in brackish water and inland saline water are presented in Table 2. The total amino acid content of BWRV and ISRV samples was 17.38 g/100 g and 16.21 g/100 g, respectively. These values were closely related to the total amino acid content of green tiger shrimp (18.68 g/100 g) by Yanar and Celik (2006). The total amino acid composition of Northern pink shrimp and Spotted shrimp was 12.59 g/100 g and 14.48 g/100 g, respectively (Heu, Kim, & Shahidi, 2003). Results from the present study concluded glutamic acid, alanine, aspartic acid, arginine, hydroxyproline, leucine, lysine as the major amino acids found in both the reared shrimps and constitutes more than 50% of the total amino acids. Arginine and glutamate were found in a higher amount in the BWRV sample than the ISRV sample. The typical seafood like flavor and sweet taste in crustaceans is

Table 2. Amino acid composition of freshly harvested *L. vannamei* (g/100 g of muscle).

Amino acids	BWRV	ISRV
Alanine*	1.03	1.21
Arginine**	1.66	0.98
Aspartic acid*	2.09	1.32
Glutamic Acid*	3.42	2.66
Glycine*	1.44	0.35
Hydroxproline*	1.42	2.81
Isoleucine**	0.70	0.92
Leucine**	1.34	1.69
Lysine**	1.45	0.71
Methionine**	0.32	0.85
Phenaylalanine**	0.37	ND
Serine*	0.67	0.95
Threonine**	0.69	0.83
Valine**	0.79	0.94
Total	**17.38**	**16.21**

BWRV- Brackish water reared *vannamei*, ISRV-Inland saline reared *vannamei*
**Essential amino acid, *Nonessential amino acid
Data are presented as the mean value of two independent analysis

attributed due to its higher content of free arginine. Higher free glutamate content in foods that have a relatively strong flavor (Methven, 2012). Yanar and Celik (2006) reported glutamic acid, aspartic acid, arginine, lysine, and leucine as the most dominating amino acids in green tiger shrimp and speckled shrimp. According to Sriket et al. (2007) the most abundant amino acid was arginine while in Black tiger shrimp (*P.monodon*) and white shrimp (*P.vannamei*) leucine, isoleucine and proline were predominant. Black tiger shrimp meat had a higher content of glutamic acid and glycine in contrast to white shrimp meat which had a higher hydroxyproline content than the black tiger shrimp meat.

Fatty acid composition of freshly harvested L. vannamei

Table 3 represents the profile study of the fatty acids in inland saline reared and brackish water reared *Litopenaeus vannamei*. From the present study, the major fatty acids found in both the shrimps (BWRV and ISRV) were PUFAs. The PUFA content of the BWRV and ISRV sample was 41.67% and 46.50%, respectively. González-Félix et al. (2002) suggested that prawn meat fat is having a higher proportion of polyunsaturated fatty acids (PUFA) such as eicosapentaenoic (20:5n3, EPA) and docosahexaenoic (22:6n3, DHA) acids. Among the PUFAs, EPA, DHA and linoleic acid were abundant fatty acids in both the samples. Linoleic acid was found at levels of 12.72% and 11.71% from BWRV and ISRV. EPA and DHA were found at levels of 11.11% and 12.22% from BWRV and 12.16% and 13.71% from the ISRV lipid sample. Gunalan,

Table 3. Fatty acid (%) composition of freshly harvested *L. vannamei.*

Fatty acid	Name	BWRV	ISRV
C8:0	Caprylic acid	1.08	1.72
C14:0	Myristic acid	1.11	0.70
C16:0	Palmitic acid	23.94	21.74
C17:0	Margaric acid	1.26	1.37
C18:0	Stearic acid	9.31	9.33
C22:0	Behenic acid	1.03	0.99
SFA		**37.73**	**35.85**
C16:1(n-7)	Palmitoleic acid	1.86	2.28
C18:1(n-9)	Oleic acid	15.86	10.93
C20:1(n-9)	Eicosenoic acid	1.12	1.27
C22:1(n-9)	Erucic acid	0.84	2.27
MUFA		**19.68**	**16.75**
C18:2(n-6)	Linoleic acid	12.72	11.71
C18:3(n-3)	α-Linolenic acid	0.61	1.41
C18:3(n-3)	Γ-Linolenic acid	1.48	3.70
C20:3(n-3)	Eicosatrienoic acid	0.45	0.33
C20:4(n-6)	Arachidonic acid	3.08	3.48
C20:5(n-3)	Eicosapentanoic acid (EPA)	11.11	12.16
C22:6(n-3)	Docosahexaenoic acid (DHA)	12.22	13.71
PUFA		**41.67**	**46.50**
Total		**99.08**	**99.10**

BWRV- Brackish water reared *vannamei*, ISRV-Inland saline reared *Vannamei*
Data are presented as the mean value of two independent analysis

Soundarapandian, & Anand, (2013) reported polyunsaturated fatty acids (PUFA) were the most predominantly found common fatty acids (38.5%) with the contents of linoleic acid (16.3%) and alpha-linolenic acid (11.2%) found at higher in *L. vannamei*. PUFAs were found as the major fatty acids in white shrimp and black tiger shrimp with the range of 42.2–44.4%. DHA and EPA were found at levels of 14.90 and8.58% in the lipid from black tiger shrimp and 9.99 and 9.46% in the lipid from white shrimp (Sriket et al., 2007). Higher levels of n-3 PUFA particularly linoleic acid, EPA and DHA would increase stress tolerance and membrane permeability indicating better growth and survival of *L. vannamei* in the culture pond (Gunalan, Tabitha, Soundarapandian, & Anand, 2013). Among the mono unsaturated fatty acid oleic acid was found abundantly in both the reared shrimps (BWRV and ISRV) as per the current study undertaken. Oleic acid was found at levels of 15.86% and 10.93% from BWRV and ISRV lipid sample. A study by Gunalan et al. (2013) revealed oleic acid as the only monounsaturated fatty acid (MUFA) that contributed 12.48% of total fatty acids. About 11.40% and 9.94% of oleic acid present in the extracted lipid from white shrimp and black tiger shrimp reported by Sriket et al. (2007). From the present study, palmitic (C16:0) and stearic acid (C18:0) were the most abundantly found saturated fatty acids in the lipid extracted from BWRV and ISRV. C16:0 and C18:0 were found at levels of 23.94% and 9.31% from BWRV and 21.74% and 9.33% from ISRV lipid samples, respectively. Rosa and Nunes (2004) studied the nutritional quality of four different species. Palmitic acid (16:0) is the predominant saturated fatty acid (SFA) from red shrimp (*Aristeus antennatus*) and pink shrimp (*Parapenaeus longirostris*). Sriket et al. (2007) also reported C16:0 and C18:0 were the most abundant saturated fatty acids in the lipid extracted from black tiger shrimp and white shrimp. Stearic acid was observed at maximum levels (12.38%) in *L. vannamei* among the saturated fatty acids by Gunalan et al. (2013). Yanar and Celik (2005) reported that C16: 0 (palmitic acid), C18: 0 (stearic acid), C16: 1 n-7 (palmitoleic acid), C18: 1 n-9 (oleic acid), C20: 4 n-6 (arachidonic acid), C20:5 n-3 (EPA) and C22: 6 n-3 (DHA) were the most abundant fatty acids in shrimps (*Penaeus semisulcatus* and *Metapenaeus monoceros*).

Mineral composition of freshly harvested L. vannamei

Minerals form an essential component of hormones, enzymes and enzyme activation and play a major role in the maintenance of the colloidal system, acid-base equilibrium balance and in the development of skeletal muscle structure (Ginson & Bindu, 2017). Mineral composition in the meats of both shrimps, *vannamei* reared in inland saline water, and brackish water is given in Table 4. BWRV shrimp meat had slightly higher (2139.52 mg/100 g) values of all minerals determined than ISRV meat

Table 4. Mineral composition of freshly harvested *L. vannamei.*

Minerals	BWRV (mg/100 g)	ISRV (mg/100 g)
Sodium	148.4 ± 1.89[a]	142.1 ± 1.70[b]
Potassium	1011 ± 20.57[a]	836.3 ± 10.43[b]
Magnesium	182.5 ± 3.76[a]	161.2 ± 4.50[b]
Calcium	57.6 ± 1.33[a]	114.2 ± 1.60[b]
Phosphorus	717.4 ± 2.89[a]	716 ± 4.56[a]
Copper	2.02 ± 0.00[a]	1.45 ± 0.01[a]
Iron	14.98 ± 0.26[a]	2.24 ± 0.02[b]
Manganese	0.72 ± 0.01[a]	0.15 ± 0.02[b]
Selenium	0.25 ± 0.03[a]	0.39 ± 0.01[a]
Zinc	4.35 ± 0.03[a]	5.11 ± 0.05[a]
Chromium	0.31 ± 0.06[a]	0.25 ± 0.03[a]
Total	**2139.52**	**1979.42**

BWRV- Brackish water reared *vannamei*, ISRV-Inland saline reared *vannamei*

Data are expressed as the mean± SD (n = 3), the mean value in the same row with different superscripts are significantly different ($p < 0.05$).

(1979.42 mg/100 g). Liable on their sources, inland waters existing for shrimp culture can be of different salinities, and therefore have variations in the ionic compositions (Boyd & Thunjai, 2003). Potassium was the dominant mineral from both BWRV and ISRV muscles (1011 and 836.3 mg/100 g) as inferred from the results. Potassium is known to play a vital role in maintaining the cell integrity as well as fluid and electrolytic balance (Gunalan et al., 2013). In crustaceans, K and Mg ions are highly essential for their normal growth, sustainance and osmoregulatory functions (Roy, Davis, Saoud, & Henry, 2007). The higher content of potassium in both the shrimp might be due to the application of potassium supplement (Muriate of potash) during the culture of shrimps. P, Mg, and Na were also found at high levels in both the shrimp meats. The Ca was found higher in the ISRV (114.2 mg/100 g) than the BWRV (57.6 mg/100 g). Calcium is necessary for blood clotting, contraction of muscles, integrity of the hard tissues, nerve transmission and as a cofactor for enzymatic procession during osmoregulation (Gunalan et al., 2013). A higher level of potassium in speckled shrimp (*Metapenaeus monoceros*) and green tiger shrimp (*Penaeus semisulcatus*) was observed by Yanar and Celik (2006). They have also found a high level of P and Na. Calcium was present at a low level in both the shrimps. Calcium contents of green tiger shrimp and speckled shrimp were on an average of around 60.28 mg/100 g and 60.44 mg/100 g, respectively. Ravichandran, Rameshkumar, and Prince (2009) investigated the mineral composition of Indian white shrimp (*P. indicus*) and they have observed phosphorus (82.4 mg/100 g) was the most dominant mineral present in the flesh of *P. indicus*. The sodium and potassium content of *P. indicus* were 29 mg/100 g and 24.3 mg/100 g, respectively. Higher values were also recorded for calcium and magnesium. From the consumer's point of view, taste, color, and

texture would be the main quality indicators and may have been affected by salinity and the presence of other minerals. But in this study no relevant difference was observed (data not shown). Hence in this study meat quality was compared by focusing the parameters like amino acid, fatty acid, and mineral profile analysis.

Conclusion

Meats of *Litopenaeus vannamei* cultured and reared in brackish and inland saline water constitutes a good source of protein and polyunsaturated fatty acids. However, the composition varied between both the cultured shrimps. The total amino acid composition of BWRV and ISRV was 17.38 g/100 g and 16.21 g/100 g. BWRV showed higher contents in amino acids like glycine, lysine, glutamic acid, aspartic acid and arginine. However the ISRV meat had a higher hydroxyproline, alanine, leucine content than the BWRV meat. The PUFA contents of BWRV and ISRV samples were 41.67% and 46.50%. Both BWRV and ISRV shrimp meats had potassium as the dominant mineral (1011 and 836.3 mg/100 g). P, Mg and Na were also found at high levels in both the shrimp meats. The differences in chemical compositions between BWRV and ISRV might be associated with the different salinity range in the cultured environment. Though the composition was varied most of the amino acids, fatty acids and minerals were comparable to one another. No variation in sensory quality parameters were observed between the two treatments. Therefore, it can be concluded from the present investigation that the nutritional quality of ISRV shrimp is not affected and this technology of culturing *L. vannamei* in inland saline water could be useful and provide income opportunities to the farmers having salt-affected land.

Highlights

- Shrimps rearing in Inland saline areas are progressing in many counties
- Biochemical constituents of inland reared shrimp were compared with brackish reared
- Slight variation in compositions of amino acids, fatty acids and mineral observed
- This culturing technology could be useful for the farmers having salt-affected land

Funding

Funded by Indian Council of Agricultural Research, Under National Agricultural Higher Education Project.

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