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Adoption of Quality Management Practices in Seafood Processing Sector in Cochin Region

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Abstract

The study was conducted in 34 fish processing units in Ernakulam and Alleppey districts of Kerala. Data were collected on the general profile of the seafood processing units, availability of infrastructural facilities and managerial role performance of fish processors. The results revealed that 76.47% of the units were EU approved and 23.53% were Non-EU units. The average quantity handled per day was 11.12 t while the production capacity was 21.51 t day^{-1}. For the availability of infrastructural facilities in the processing units, the adequacy index was more than 90. The overall role performance index of the fish processors was found to be 74.46. The adoption of quality management practices was determined in terms of good hygienic practices (Mean: 99.51%), good manufacturing practices (Mean: 97.65%), standard sanitation operation procedures (Mean: 99.08%) and good laboratory practices (Mean: 96.33%). The significant 'F' value in the multiple regression analysis revealed the overall significance of influence of 14 independent variables when taken together in explaining the extent of adoption of good hygienic practices by the fish processing units. Of the fourteen variables, only type of approval and adequacy of infrastructural availability in the processing units positively contributed towards the extent of adoption of quality management practices. The R^2 value indicated that the 14 variables selected together explained 67.70% of variation in the adoption level. The major constraints expressed by the processors were also listed out.

Key words: Adoption, good hygienic practices, good manufacturing practices, good laboratory practices, seafood processing

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Introduction

As stringent quality norms are being enforced by various agencies in seafood trade, the adoption of quality management practices has to be monitored and the innovation-diffusion efforts have to be strengthened to improve the extent of adoption. The managerial role performance in fish processing units and the extent of adoption of quality management practices have to be analysed to improve the productivity of enterprises and to provide feedback information. Further, identification of problem areas and suitable interventions are essential to motivate the people involved. This would improve the quality and thereby ensure better prices for their commodity, which will also ensure safety of fish consumers. Hence, the present study was conducted with the following specific objectives: (i) to analyse the general profile of the seafood processing units; (ii) to study the managerial role performance in fish processing units; (iii) to assess the availability of infrastructural facilities; (iv) to find out the extent of adoption of good hygienic practices, good manufacturing practices, standard sanitation operation procedures and good laboratory practices; and (v) to identify the operational constraints in the adoption of quality management practices.

Materials and Methods

The study was conducted during 2007-09, among the fish processing units in Ernakulam and Alleppey districts of Kerala. From the list of 74 active fish processing plants (production units), 34 fish processing units were selected for the study by simple random sampling. A random method of selection is one which gives each of the 'N' units in the population to be covered, a calculable probability of being selected (Snedecor & Cochran, 1971) and for this, the random table was used. Quality management practices to be followed in fish processing plants were listed out and measurement techniques of selected dependent and independent variables were determined.

Adequacy index for the availability of infrastructural facilities was calculated on a three-point rating scale *viz.,* adequate, partially adequate and not adequate, with the scoring pattern of 2, 1 and 0 respectively. Adoption index was calculated for each variable such as Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), Standard Sanitation Operation Procedures (SSOP) and Good Laboratory Practices (GLP) by using a three-point scale *viz.*, adopted, partially adopted and not adopted, with the scoring pattern of 2, 1 and 0 respectively for measuring the adoption of selected practices listed in the schedule. Each index was calculated as the ratio of actual score obtained to the maximum score possible and expressed in percentage for each respondent (Balasubramaniam & Perumal, 1990; Balasubramaniam et al., 1998; 2000).

In this study, managerial role performance was operationally defined as the extent of performance of various roles by quality control managers in terms of the level of performance in a year through a four-point rating scale *viz.,* outstanding, good, average and needs improvement, with the scoring pattern of 4, 3, 2 and 1 respectively. From the response scores, Role Performance Index was calculated for each respondent by the ratio of actual score obtained to the maximum score possible and expressed in percentage (Balasubramaniam & Perumal, 1991; Mary et al., 1996). Using structured interview schedules and observation methods, the data were collected from the respondents. The data were analyzed using various statistical tools *viz*., percentage, mean, standard deviation, correlation and regression using the statistical packages for social sciences (SPSS Ver. 16.0).

Results and Discussion

The general profile of the seafood processing units studied is given in Table 1. It was found that 76.47% of the processing plants was EU approved and nearly 95% of the units was engaged in 'integrated' type of processing. It was also observed that 88.24% of the plants was engaged in processing only 'marine raw materials', and 11.76% of the units was processing both 'marine and aquaculture' raw materials. The average quantity handled per day was 11.12 t while the production capacity was 21.51 t day^{-1}. Majority of the units (94.12%) were following block and IQF type of freezing. The frozen storage, chilled storage and ice production capacity of the units were 212.53, 7.47 and 21.59 t day^{-1} respectively. All the units were operating two shifts per day with the average of 288 working days. Nearly three fourth of the plants (76.47%) were following 98/83 EC Directive for testing the water. The source of potable water was well/ bore well for 85.30% of the units, while 11.76% of the units depended on public water supply and only 2.94% of units used reverse osmosis (RO) as potable water source. An earlier study (Balasubramaniam & Krishna, 2003) reported that in Cochin region, the processing factories were mostly either IPQC type of units (40%) or EU approved units (50%) and the number of days of work was 303.6 with the average daily production of 9 t. The standard deviation values pertaining to some components of the variable 'manpower' were high due to wide variations among the sample units (Table 1).

The data on adequacy of infrastructural facilities available in the processing units are given in Table 2. From the table, it could be inferred that the 'Adequacy Index' was more than 90 for the availability of infrastructural facilities in the processing units such as area of processing unit, availability of potable water, water treatment facilities, effluent treatment facilities, drainage facilities, toilet facilities, waste disposal facilities, equipments and machineries, laboratory equipments and facilities, rest/ dining room for the workers and fly proof netting.

The self assessment scores on managerial role performance in the fish processing units are presented in Table 3. The overall role performance mean score was 2.97 in the rating scale of 1 to 4 with the standard deviation of 0.43. The index score was between 70 and 75 for all the fifteen characteristics *viz*., ensuring quality management/food safety measures, productivity, quality of work, job knowledge, decision making, problem solving, skill set, communication skills, initiative, leadership, time management, human resource management, motivation, stress management and need for achievement. Most of the respondents had assessed their role performance as 'good' and hence the 'Average Role Performance Index' was also quite high (74.46).

The scores on the extent of adoption of good hygienic practices indicated that the overall 'Adoption Index' was 99.51 (Table 4). The adoption index was extremely good for all the fifteen practices *viz*., use of uniform, apron, cap and shoes by workers (100.00), cleaning of hands and feet while entering the unit (98.53), use of soap/germicide for cleaning

Table 1. General profile of the seafood processing units (n = 34)

Profile characteristics	Percentage	Mean± SD
I. Qualitative Variables		
Type of approval		
a) EU	76.47	-
b) Non EU	23.53	-
Control of pre-processing		
a) Integrated (Pre-processing and processing)	94.12	-
b) Processing only	5.88	-
Source of raw materials		
a) Marine	88.24	-
b) Marine and aqua farms	11.76	-
Type of freezing		
a) Block and IQF	94.12	-
b) IQF	5.88	-
Manpower		
a) Technologists - Male	-	1.00 ± 01.33
b) Technologists - Female	-	1.97 ± 01.24
c) Supervisors - Male	-	5.41 ± 02.80
d) Supervisors - Female	-	0.60 ± 01.58
e) Pre-processing workers - Male	-	9.79 ± 16.43
f) Pre-processing workers - Female	-	92.94 ± 72.41
g) Processing workers - Male	-	13.47 ± 09.32
h) Processing workers - Female	-	42.97 ± 30.89
Type of testing water		
a) 98/83 EC	76.47	-
b) IS 4251	23.53	-
Source of potable water		
a) Well/ bore well	85.30	-
b) Public water supply	11.76	-
c) Reverse Osmosis	2.94	-
II. Quantitative Variables		
Quantity handled (t day^{-1})	-	11.12 ± 08.94
Production capacity (t day^{-1})	-	21.51 ± 09.38
Frozen storage capacity (t)	-	212.53 ± 159.37
Chilled storage capacity (t)	-	7.47 ± 08.36
Ice production capacity (t day^{-1})	-	21.59 ± 12.94
Days of work in a year	-	288.24 ± 62.07
Number of shifts	-	2.00 ± 00.67

hands and feet (98.53), periodical medical check-ups for the workers (100.00), periodical training of technologists/ workers on quality control and food safety aspects (100.00), suitable and clean place for processing-smoothness of contact surfaces, corrosion resistance, proper lighting and ventilation (100.00), use of stainless steel tables for processing (100.00), use of adequate potable water for washing (100.00), use of adequate quantity of soaps and detergents (100.00), use of chlorinated water for washing (100.00), use of recommended cleaning schedule (98.53), maintaining a high degree of personal cleanliness (98.53), handling of ice hygienically to avoid bacterial contamination (98.53), use of adequate rodent control measures (100.00) and use of chloritest paper for measuring the chlorine level in water (100.00). Balasubramaniam & Krishna (2003) reported that the adoption of critical practices

Table 2. Availability of infrastructural facilities in the processing units (n=34)

Infrastructural facilities	Adequacy Index
Area of processing unit	92.65
Availability of potable water	97.06
Water treatment facilities	95.59
Effluent treatment facilities	97.06
Drainage facilities	100.00
Toilet facilities	100.00
Waste disposal facilities	98.53
Equipments and machineries	100.00
Laboratory equipments and facilities	100.00
Rest/ dining room for the workers	97.06
Fly proof netting	97.06

Table 3. Managerial role performance in fish processing units (n = 34)

Characteristics	Mean Score ± SD	Performance Index
Ensuring quality management/ food safety measures	3.03 ± 0.39	75.74
Productivity	2.97 ± 0.39	74.26
Quality of work	2.97 ± 0.46	74.26
Job knowledge	3.06 ± 0.49	76.47
Decision making	3.00 ± 0.35	75.00
Problem solving	2.97 ± 0.39	74.26
Skill set	3.00 ± 0.43	75.00
Communication skills	3.03 ± 0.46	75.74
Initiative	3.03 ± 0.39	75.74
Leadership	2.97 ± 0.39	74.26
Time management	3.00 ± 0.43	75.00
Human resource management	2.94 ± 0.42	73.53
Motivation	2.91 ± 0.51	72.79
Stress management	2.91 ± 0.45	72.79
Need for achievement	2.88 ± 0.48	72.06
Overall Role Performance	2.97 ± 0.43	74.46

such as observing personal hygiene, use of adequate water for washing, proper icing of materials, proper method of storage and use of cleaning schedules had increased as a result of organizing periodical refresher training courses among processing workers.

Table 4. Adoption of Good Hygienic Practices (n = 34)

Practices	Mean Score ± SD	Adoption Index
Use of uniform, apron, cap and shoes by workers	2.00 ± 0.00	100.00
Cleaning of hands and feet while entering the unit	1.97 ± 0.17	98.53
Use of soap/ germicide for cleaning hands and feet	1.97 ± 0.17	98.53
Periodical medical check-ups for the workers	2.00 ± 0.00	100.00
Periodical training of technologists/ workers on quality control and food safety aspects	2.00 ± 0.00	100.00
Suitable and clean place for processing	2.00 ± 0.00	100.00
Use of stainless steel tables for processing	2.00 ± 0.00	100.00
Use of adequate potable water for washing	2.00 ± 0.00	100.00
Use of adequate quantity of soaps and detergents	2.00 ± 0.00	100.00
Use of chlorinated water for washing	2.00 ± 0.00	100.00
Use of recommended cleaning schedule	1.97 ± 0.17	98.53
Maintaining a high degree of personal cleanliness	1.97 ± 0.17	98.53
Handling of ice hygienically to avoid bacterial contamination	1.97 ± 0.17	98.53
Use of adequate rodent control measures	2.00 ± 0.00	100.00
Use of chloritest paper for measuring the chlorine level in water	2.00 ± 0.00	100.00
Overall Adoption Index	1.99 ± 0.06	99.51

Brajmohan et al. (2003) revealed that the technological gaps in the adoption of improved fish processing practices were 67.50, 65.00, 42.50, 25.00, 10.00, 7.50, 5.00 and 5.00% in the adoption of use of deodorants, use of recommended packaging materials for individually quick frozen (IQF) shrimps, use of antiseptic ointment, 60 gauge high molecular weight high density polythene film or 60 gauge linear low density polythene for use as inner wrap for frozen fish/ shrimp packaging, use of quick freezers, strapping materials of the master carton (12 mm

wide polypropylene straps), glazing (before/after freezing the material) and use of quality assurance systems, respectively.

The overall adoption index of Good Manufacturing Practices (GMP) was 97.65 (Table 5.). The adoption index was extremely good for all the ten practices *viz.*, facilities (97.06), personnel (97.06), sanitary facilities and control (100.00), equipments and utensils (100.00), process control (100.00), personal hygiene (98.53), training (92.65), chemical control (94.12), traceability and recall (98.53) and pest control (98.53).

Table 5. Adoption of Good Manufacturing Practices (GMP) (n = 34)

Practices	Mean Score ± SD	Adoption Index
Construction and maintenance of infrastructural facilities and ensuring linear product flow to control contamination	1.94 ± 0.34	97.06
Personnel management to ensure cleanliness, education and training of personnel	1.94 ± 0.34	97.06
Maintenance of sanitary facilities and control	2.00 ± 0.00	100.00
Design, specification and cleaning methods of all equipments and utensils installed for production	2.00 ± 0.00	100.00
Process control viz., receiving, inspecting, transporting, segregating, preparing, manufacturing, packaging and storing of food in such a way that it does not lead to contamination	2.00 ± 0.00	100.00
Following the requirements of personal hygiene	1.97 ± 0.17	98.53
Training of all employees in personal hygiene, GMP, cleaning and sanitation procedures and HACCP	1.85 ± 0.44	92.65
Documented procedures to assure the segregation and proper use of non-food chemicals	1.88 ± 0.41	94.12
Maintenance of traceability and recall system data	1.97 ± 0.17	98.53
Use of effective pest control programs	1.97 ± 0.17	98.53
Overall Adoption Index	1.95 ± 0.20	97.65

The overall adoption index of Standard Sanitation Operation Procedures (SSOP) was 99.08 (Table 6.). The adoption index was extremely good for all the eight practices *viz*., safety of water that comes in contact with food or food contact surfaces (100.00), condition and cleanliness of food contact surfaces including utensils, gloves and outer garments (95.59), prevention of cross contamination (100.00), maintenance of hand washing, sanitizing and toilet facilities (98.53), protection of food, food packaging materials and food contact surfaces from adulteration with lubricants, fuel, pesticides, cleaning compounds, sanitizing agents, condensates and other chemical, physical and biological contaminants (100.00), proper labeling, storage and use of toxic compounds (98.53), control of employee health conditions that could result in the microbiological contamination of food, packaging materials, food contact surfaces (100.00) and exclusion of pests from the food plant (100.00).

Table 6. Adoption of Standard Sanitation Operation Procedures (SSOP) (n = 34)

Practices	Mean Score ±SD	Adoption Index
Safety of water that comes in contact with food or food contact surfaces	2.00 ± 0.00	100.00
Condition and cleanliness of food contact surfaces, including utensils, gloves and outer garments	1.91 ± 0.29	95.59
Prevention of cross contamination	2.00 ± 0.00	100.00
Maintenance of hand washing, sanitizing and toilet facilities	1.97 ± 0.17	98.53
Protection of food, food packaging materials and food contact surfaces from adulteration with contaminants	2.00 ± 0.00	100.00
Proper labeling, storage and use of toxic compounds	1.97 ± 0.17	98.53
Control of employee health conditions that could result in the microbiological contamination	2.00 ± 0.00	100.00
Exclusion of pests from the food plant	2.00 ± 0.00	100.00
Overall Adoption Index	1.98 ± 0.08	99.08

With regard to Good Laboratory Practices (GLP), the overall adoption index was 96.33 (Table 7.). The adoption index was mostly good for all the four practices *viz*., adoption of BIS standards and EU Norms (97.06), use of calibrated instruments (100.00), approval of labs by National agencies like CIFT, EIA and MPEDA (94.12) and record keeping (94.12).

The correlation and regression coefficient values calculated between the profile characteristics and adoption of good hygienic practices are given in Table 8. The correlation analysis revealed that the variables *viz*., type of approval, type of freezing and adequacy of infrastructural availability in the processing units were found to have positive relationship with the adoption of quality management practices which indicated that when these scores improve, the adoption scores could be more and vice versa. The variables *viz*., control of pre-processing, source of raw materials, quantity handled, production capacity, chilled storage capacity, frozen storage capacity, ice production capacity, manpower engaged, days of work in a year, type of testing water and managerial role performance did not have any association with the adoption. The contribution of the profile characteristics towards adoption is also indicated by the regression coefficients given in the table. The R^2 value indicated that all the variables taken together served as cause for 67.70% of variation in the adoption level. The significant 'F' value revealed the overall significance of the regression. Of the fourteen variables, only type of approval and adequacy of infrastructural availability in the processing units had contributed positively and significantly towards the extent of adoption of good hygienic practices ($p<0.01$). Brajmohan et al. (2003) reported that the number of days of work in a year did not show any relationship

Table 7. Adoption of Good Laboratory Practices (GLP) (n = 34)

Practices	Mean Score ± SD	Adoption Index
Adoption of BIS standards and EU Norms	1.94 ± 0.24	97.06
Use of calibrated instruments	2.00 ± 0.00	100.00
Approval of labs by National agencies like CIFT, EIA and MPEDA	1.88 ± 0.41	94.12
Record keeping	1.88 ± 0.41	94.12
Overall Adoption Index	1.92 ± 0.38	96.33

Table 8. Correlation and regression analyses between the profile characteristics and adoption of good hygienic practices (n=34)

Profile Characteristics	Correlation coefficients (r)	Regression coefficients (b)	SE of 'b'	't'
Type of approval	0.594**	0.850	0.316	2.962**
Control of pre-processing	-0.044	0.130	0.560	0.831
Source of raw materials	0.064	0.253	0.442	1.502
Quantity handled (t day^{-1})	0.081	0.060	0.020	0.287
Production capacity (t day^{-1})	0.038	-0.343	0.021	-1.521
Type of freezing	0.343*	0.179	0.169	1.071
Frozen storage capacity (t)	0.180	0.266	0.001	1.035
Chilled storage capacity (t)	0.116	0.160	0.017	0.944
Ice production capacity (t day^{-1})	0.295	-0.136	0.018	-0.496
Manpower engaged	0.228	-0.067	0.002	-0.343
Days of work in a year	-0.090	-0.204	0.002	-1.304
Type of testing water	0.290	-0.370	0.443	-1.602
Adequacy of infrastructural facilities in the processing unit	0.497**	0.378	0.103	1.973*
Managerial role performance	-0.044	0.033	0.031	0.174

(** Significant at 1% level; * Significant at 5% level; $R^2 = 0.677$; $F = 2.846$*)

with the adoption behaviour of fish processors, whereas in the case of fish pre-processors, it showed positive and significant relationship.

The general constraints such as occurrence of sulphite content and antibiotic residues in shrimps, scarcity of raw materials, lack of availability of kits in the market for antibiotic residue testing, lack of proper training for the workers, work load and time constraint were reported by the respondents. To achieve the availability of safe seafood and to ensure the safety of the consumers, it is of utmost importance to adopt quality management practices in seafood processing. In this context, the results of the study revealed the general profile of the seafood processing units and the extent of adoption of various quality management practices. The findings of the present study would also be helpful in planning and implementing suitable extension programmes to popularize the quality control variables.

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