A SURVEY OF THE MICROBIOLOGICAL QUALITY OF COMMERCIAL FROZEN PRAWN PRODUCTS

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[The paper presents the results of a bacteriological survey carried out on 2917samples of frozen prawn ,55 samples of raw material, 35 samples of water, 4 samples of ice and 42 samples of various equipments used for processing. The survey covered a period of three years (1960 - '63) and comprised of samples collected from five of the leading processing factories in Cochin. Frozen products tested consisted of headless (marine and fresh water), peeled and deviened and cooked frozen samples. Statistcal analysis of the data shows that there is no significant variation between samples and between factories with respect to product quality. The standard plate count varied between 1.0×10^4 and 1.0×10^6 per gram for headless and between 1.0×10^4 and 1.0×10^7 for peeled and deveined and cooked frozen samples. Majority of the samples had bacterial load well within the limits prescribed for such products.]

Introduction

The problem of high bacterial counts in processed fishery products is one of the most perplexing things that a processor has to face. Bacterial contamination of the product can happen in more than one way. The numerous organisms harboured in the slime, gills and guts of the fish find slow entry into the flesh after death. If sufficient precautions are not taken soon after catching to prevent such entry, the meat may become contaminated by heavy bacterial load in a matter of hours (Velankar et. al., 1961). Equally dangerous is the possibility of external contamination. This can happen from unclean surfaces with which the material comes into contact during transportation and in the processing plant, from the water and ice used in processing, from the workers' hands, clothes etc. Control measures at every stage are needed to avoid such contamination and these are in the form of using stainless steel or other non-corrosive metallic surfaces and vessels, adopting regular plant chlorination procedures and frequent sterilization of the vessels and appliances, copious use of well treated water and ice etc.

In the processing plant, the bacterial load may undergo several natural changes, depending of course on the type of processing adopted. For example, in freezing operations, the initial washing usually removes more than 90% of the surface bacterial load. Between this stage and the final freezing, there may be an increase in the bacterial load due partly to the slow multiplication of the residual bacteria in the material and partly due to external contamination. This will again be considerably reduced during deep freezing, when it has been found that more than 90% of the residual bacteria are destroyed leaving only a balance of about 10% (Shewan, 1949).

It can thus be seen that the count obtained in a frozen product is the net balance of all the above changes. This in itself is indicative that a correct interpretation of the original condition of the raw material based on the final bacterial count is very difficult and confusing. On the other hand, it is evident that, if freezing had been done properly without external contamination, the bacterial load of the finished product should be less than 1% of the original load. Anything contrary to this is indicatve of wrong factory practices or insanitary conditions and hence necessitates a critical examination from the point of view of health hazard to the consumers. Detailed bacteriological examination of frozen products is thus an essential step in deciding their suitability for human consumption, although the counts may not indicate the product quality as such.

The work detailed in the present communication has to be viewed against this background. In a rapidly expanding field like the prawn freezing industry, which is only of recent origin in the country, the need for evaluating the overall performance was felt by both the industry and the technologists as early as 1960. Besides many porblems of vital importance to the industry aimed at improving product quality, working out better preservation techniques etc., a general survey of the bacterial quality of the finished product was also undertaken. The survey is being continued ever since 1960 and the data collected over a period of three years are presented in the paper. A total of 2917 samples of frozen prawn drawn from different types of packing from the different processing factories were examined during this period.

A few series of experiments were also carried out in which the bacterial counts of prawn muscle were followed during different stages of processing. This was done to study fully the changes brought about in the material during preparation and processing by the different environmental conditions as well as to clearly establish the causative agents for contamination of the products, if any, during these operations. These data were also necessary for working out corrective measures for the maintenance of quality of the products.

Materials and Methods

Regular visits were made to five of the processing factories in Cochin area during the period of 1960-1963. Samples of frozen prawn products kept in their frozen storages were selected at random and a composite sample of about 50 gm. was taken from different parts of the frozen block. This was blended with 450 ml. of sterile aged seawater and serial dilutions of the homogenate were plated out in duplicate onto seawater agar. The plates were incubated at room temperature for 48 hrs. and appropriate plates counted. A comparative study of seawater agar with nutrient agar had previously shown that sea water agar was a better medium for the determination of total plate count. The same procedure was adopted for the determination of standard plate count of the material through different stages of processing. In addition to this, analysis of samples of water, ice, etc. used in the processing hall and of the utensils used for handling the raw material was carried out simultaneously.

A detailed productwise and factorywise distribution of the samples tested is shown in Table I.

TABLE — I

DISTRIBUTION OF SAMPLES OF FROZEN PRAWN ANALYSED DURING 1960—63

Description of sample	Factory I	Factory II	Factory III	Factory IV	Factory V	Total
Headless (Marine)	86	188	79	116	115	584
Konchu (Freshwater)	70	52	47	38	98	305
Peeled and deveined fresh frozen, above 70/lb	219	190	268	170	107	954
Peeled and deveined, fresh frozen, above 71/lb	46	73	144	84	133	480
Peeled and deveined, cooked frozen	46	Nil	27	85	89	347
Cooked, peeled and frozen	42	Nil	171	27	107	247
Total	509	503	736	520	649	2917

Results and Discussion

The results of the bacteriological survey of the commercial samples are shown in Tables II and III. The data are presented as the percentage of samples falling into different ranges of total plate count both factorywise and varietywise.

TABLE – II

PERCENTAGE OF SAMPLES FALLING INTO DIFFERENT RANGES OF BACTERIAL COUNT ACCORDING TO TYPE OF FROZEN PRODUCT

Range of bacterial count	Headless	Konchu	P & D upto 70 lb	P & D above 71/lb	CPD	CP
1×10^3	0·2	Nil	Nil	Nil	0·8	Nil
$1 \times 10^3 - 1 \times 10^4$	4·8	2·0	0 5	0·9	10·1	3·2
$1 \times 10^4 - 1 \times 10^5$	44·5	25·6	16·8	6·6	31·6	11·2
$1 \times 10^5 - 1 \times 10^6$	41·1	49·8	64·9	56·6	35·3	51·0
$1 \times 10^6 - 1 \times 10^7$	8·9	21·0	16·6	34·6	20·2	31·4
$1 \times 10^7 - 1 \times 10^8$	0·5	1·6	1·2	1·3	2·0	3·2

TABLE – III

PERCENTAGE OF SAMPLES FALLING INTO DIFFERENT RANGES OF BACTERIAL COUNT — PRODUCTWISE AND FACTORYWISE

Range of bacterial count			1×10^3	$1 \times 10^3 - 1 \times 10^4$	$1 \times 10^4 - 1 \times 10^5$	$1 \times 10^5 - 1 \times 10^6$	$1 \times 10^6 - 1 \times 10^7$	1×10^7
Headless	Factory	I	Nil	3.5	44.2	36·0	16·3	Nil
Prawn		II	Nil	4.8	46.3	45·2	3·7	Nil
(Marine)		III	Nil	5.0	50.5	36·7	7.8	Nil
		IV	0.9	7·8	52·6	31·0	6·8	0·9
		V	Nil	2.6	29·5	51·3	14·8	1·8
Konchu	Factory	I	Nil	Nil	15·7	60·0	24·3	Nil
(Fresh		II	Nil	1·9	30·8	57.7	5·8	3·8
water)		III	Nil	2·1	38·3	44·7	14·9	Nil
		IV	Nil	Nil	29·0	60·5	10·5	Nil
		V	Nil	4·1	22·4	36·7	33·7	3·1
P & D frozen	Factory	I	Nil	Nil	11·4	64·0	23·3	1·3
Prawns		II	Nil	Nil	10·5	69·5	19·5	0·5
(up to 70/ lb)		III	Nil	Nil	15·0	72·4	12·6	Nil
		IV	Nil	2·35	33·5	57·7	4·1	2·35
		V	Nil	1.0	17·7	51·4	27·1	2·8
P & D frozen	Factory	I	Nil	Nil	2·2	54.3	39·1	4·4
Prawn		II	Nil	1·4	4·1	74·0	20·5	Nil
(above 71/ lb)		III	Nil	1·4	4·8	61·1	32·0	0.7
		IV	Nil	1·2	22·6	62·0	11·9	2.3
		V	Nil	Nil	1.5	39·8	58·0	0.7

Table continued...

C P D frozen prawn	Factory	I	Nil	2·2	30·4	39.1	28·3	Nil
		III	Nil	Nii	3·7	63·0	29·6	3·7
		IV	2.3	17·6	57.6	19·0	1.2	2.3
		V	Nil	10.1	15·7	40.5	31·5	2·2
C P frozen prawn	Factory	I	Nil	Nil	4·8	40·5	38·1	16·6
		III	Nil	Nil	6·4	57.9	33·8	1·9
		IV	Nil	26·0	55·5	18·5	Nil	Nil
		V	Nil	3.7	10·3	52·3	32·7	1·0

For each variety, analysis of variance was performed by taking random samples from that bacterial range in which the majority of samples from each factory lie. It was obesrved that for most of the varieties, the variation between factories as well as variation between samples are not significant at 5% level. Therefore, it is not unreasonable to conclude that all the five factories produce frozen products of different types which have more or less the same quality.

The data corresponding to each type from the five factories were pooled together and statistically analysed. The results are represented in Table IV.

TABLE — IV

ANALYSIS OF VARIANCE OF THE STANDARD PLATE COUNTS

		S. S.	d. f.	M. S. S.	F	5% F	Remarks
Frozen headless prawn (samples with bacterial count ranging from 1×10^4 to 1×10^5 organisms/gm)	Total	192·55	29				
	Between factories	19·60	4	4·90	0·7504	2.87	Not significant
	Between samples	42.28	5	8·46	1·2960	2.71	do
	Error	130.67	20	6·53			
do (1×10^5 to 1×10^6 organisms/gm)	Total	67·25	29				
	Between factories	10.70	4	2·67	1·343	2·87	Not significant
	Between samples	16·69	5	3.34	1.674	2·71	do
	Error	39·86	20	1.99			
Frozen Konchu (Fresh water Prawn)	Total	192.48	29				
	Between factories	30.223	4	7·556	1.569	2·87	Not significant
	Between samples	65.926	5	13.185	2.739	2.71	Just significant
	Error	96.331	20	4.816			
Frozen P & D prawns (up to 70/lb.	Total	180.71	29				
	Between factories	26 98	4	6.745	1.169	2.87	Not significant
	Between samples	38.35	5	7.670	1.329	2.71	do
	Error	115·38	20	5.769			
Peeled, deveined and cooked	Total	93.17	23				
	Between factories	21.14	3	7·047	1·7	3.29	Not significant
	Between samples	9.86	5	1.972	0.48	2.90	do
	Error	62.17	15	4.145			

The data presented above show that the variation between samples and between factories is not significant at 5% level except in one case.

The minimum, median, three quarter value and maximum values of standard plate count for the different types of frozen products from the different factories are represented in Table V.

TABLE — V

DISTRIBUTION VALUES FOR STANDARD PLATE COUNTS OF FROZEN PRAWN

	Minimum	Median	3/4 value	Maximum
Factory — I				
Headless	4.0×10^{3}	1.08×10^{5}	5.3×10^{5}	7.9×10^{6}
Konchu	2.1×10^{4}	3.13×10^{5}	9.0×10^{5}	6.43×10^{6}
P & D upto 70/lb.	1.55×10^{4}	3.18×10^{5}	9.7×10^{5}	2.10×10^{7}
P & D above 71/lb.	9.3×10^{4}	7.21×10^{5}	1.7×10^{6}	3.9×10^{7}
C P D	6.1×10^{3}	5.5×10^{5}	$1.2 \times 1\ ^{6}$	2.5×10^{6}
C P	4.3×10^{4}	1.2×10^{6}	3.4×10^{6}	1.9×10^{7}
Factory — II				
Headless	3.0×10^{3}	9.1×10^{4}	2.5×10^{5}	2.1×10^{6}
Konchu	7.2×10^{3}	$1\ 7 \times 10^{5}$	$4\ 9 \times 10^{5}$	4.0×10^{7}
P & D upto 70/lb.	1.4×10^{4}	3.5×10^{5}	7.9×10^{5}	2.5×10^{7}
P & D above 71 lb.	7.5×10^{3}	3.5×10^{5}	7.6×10^{5}	5.5×10^{6}
Factory — III.				
Headless	2.8×10^{3}	8.4×10^{4}	2.2×10^{5}	$8\ 4 \times 10^{6}$
Konchu	3.4×10^{3}	1.7×10^{5}	4.6×10^{6}	7.9×10^{6}
P & D upto 70/lb	1.2×10^{4}	2.8×10^{5}	5.6×10^{5}	8.1×10^{6}
P & D above 71/lb,	2.6×10^{3}	5.3×10^{5}	1.5×10^{6}	2.3×10^{7}
C P D	9.1×10^{4}	6.0×10^{5}	1.5×10^{6}	1.2×10^{7}
C P	1.5×10^{4}	6.0×10^{5}	1.3×10^{6}	3.7×10^{7}
Factory — IV.				
Headless	3.0×10^{2}	6.4×10^{4}	2.1×10^{5}	1.1×10^{7}
Konchu	1.8×10^{4}	2.6×10^{5}	4.6×10^{5}	2.7×10^{6}
P & D upto 70 lb.	3.3×10^{3}	1.6×10^{5}	4.5×10^{5}	8.4×107
P & D above 71/lb.	5.3×10^{3}	1.8×10^{5}	6.6×10^{5}	7.2×10^{7}
C P D	7.0×10^{2}	4.6×10^{4}	7.8×10^{4}	1.9×10^{7}
C P	1.1×10^{3}	2.0×10^{4}	5.9×10^{4}	5.0×10^{5}
Fnctory — V				
Headless	6.7×10^{3}	1.9×10^{5}	5.9×10^{5}	1.9×10^{7}
Konchu	4.1×10^{3}	5.1×10^{5}	1.6×10^{5}	4.0×10^{7}
P & D upto 70 lb.	8.3×10^{3}	5.2×10^{5}	1.2×10^{6}	1.3×10^{7}
P & D above 71 lb.	2.8×10^{4}	1.1×10^{6}	2.3×10^{6}	1.7×10^{7}
C P D	2.0×10^{3}	3.7×10^{5}	1.5×10^{6}	1.5×10^{7}
C P	$2\ 6 \times 10^{3}$	6.8×10^{5}	1.4×10^{6}	1.0×10^{7}

TABLE — VI

CHANGES IN STANDARD PLATE* COUNT OF PRAWN THROUGH DIFFERENT STAGES OF PROCESSING

Sl. No.	Description of sample	Stage of processing		
		Raw material	After washing arranging in trays and adding glazing water	After Freezing
1.	Backwater prawn headless	4.0×10^4	8.2×10^4	1.2×10^5
2.	,,	1.0×10^4	8.0×10^4	2.5×10^4
3.	,,	2.1×10^4	4.9×10^4	6.4×10^4
4.	,,	1.3×10^5	1.2×10^5	7.4×10^4
5.	,,	7.0×10^5	3.6×10^5	4.7×10^5
6.	,,	1.2×10^5	1.2×10^5	1.5×10^4
7.	Seaprawn headless	2.0×10^4	4.9×10^4	2.6×10^5
8.	,,	3.5×10^5	4.4×10^7	1.3×10^5
9.	Backwater prawn P & D	1.9×10^5	1.8×10^5	5.3×10^4
10.	,,	1.2×10^5	2.5×10^5	3.5×10^4
11.	,, fantail	1.8×10^5	5.7×10^4	3.0×10^5
12.	,, P & D	7.0×10^6	8.7×10^5	4.5×10^5
13.	,,	1.9×10^5	1.8×10^5	5.3×10^4
14.	,, fantail	1.2×10^5	2.5×10^5	7.3×10^4
15.	,,	7.3×10^4	5.7×10^4	2.8×10^5
16.	,, P & D	7.0×10^6	7.4×10^4	5.3×10^4
17.	Seaprawn fantail	2.8×10^5	3.1×10^5	1.7×10^5
18.	,, P & D	1.8×10^5	4.7×10^5	1.2×10^5
19.	,,	2.6×10^5	4.7×10^5	3.0×10^5
20.	,,	8.4×10^5	3.8×10^5	1.9×10^6
21.	,,	5.9×10^5	3.6×10^5	2.4×10^6
22.	,,	2.8×10^6	5.0×10^5	1.1×10^6
23.	,,	1.1×10^6	8.3×10^5	1.0×10^6
24.	,,	7.5×10^6	4.9×10^5	5.4×10^5
25.	,,	1.0×10^7	1.4×10^5	6.5×10^4
26.	,, fantail	6.4×10^5	6.7×10^5	5.4×10^4
27.	,, P & D	7.6×10^5	1.8×10^5	3.8×10^5
28.	,, butterfly	2.2×10^5	1.1×10^5	8.6×10^4
29.	,, P & D	3.7×10^6	7.8×10^5	1.9×10^5
30.	,,	3.6×10^5	2.1×10^5	9.1×10^4

* Standard plate count expressed as the number of organisms per gram of material.

In the case of Factories II and IV the three-quarter value for all types of products lie below 10^6 organisms per gram, which can probably be attributed to slightly better hygienic practices followed by these two factories. The precooked frozen samples from Factories I, III and V show counts far beyond the expected limits and require further improvement. The data from Table II indicate that in the case of headless prawn, both sea and freshwater, over 80% of the samples tested give bacterial counts within the range $1 \times 10^4 - 9.8 \times 10^5$. Peeled and deveined prawns on the whole show a wider range of bacterial count, 95% of the samples lying within the range of 1.0×10^4 to 1.0×10^7 (more than 55% being within the range of $1 \times 10^5 - 1 \times 10^6$). More or less the same trend is observed when the data gathered from individual factories are examined separately (Table III). This is clear proof to show that peeled and deveined prawns invariably give a higher bacterial count than headless prawns although both are processed under identical conditions in the same factory. The larger surface areas exposed to bacterial attack in peeled and deveined prawns will result in such differences. However, the data presented in the above tables show that even peeled cooked and frozen as well as cooked, peeled and frozen prawns also show a tendency to give higher ranges of bacterial counts. This is undesirable as a lower limit is always set for bacterial count of precooked or partially cooked foods (Anon, 1952; Fitzgerald, 1947; Frechette and Michael, 1961; Rayman et. al., 1955). Drastic control measures may have to be adopted to keep down the bacterial counts in these products.

The changes in the bacterial counts of the same lot of raw material through 3 definite stages of processing viz., raw material stage, just before going into the freezer and after freezing are represented in Table VI.

It may be seen that the figures for bacterial counts obtained at each stage are greater than in the previous stage in a number of cases, contrary to what could be expected under ideal conditions of processing. Most of the frozen samples gave counts either equal to or more than that of the corresponding raw material. Subsequent studies were therefore made to find out the factors responsible for such high standard plate counts. The results are tabulated in Table VII. The data clearly indicate that certain other factors also interfere with the bacteriological pattern of the products.

From Table VII it is evident that the surfaces that come into contact with the material, vessels used to hold raw material, water used for processing work and ice used for chilling the material and for the preparation of glazing water are heavily contaminated and that these may contribute to a substantial increase in the bacterial load of the material during the preparation stages. After freezing, the products may be further contaminated by the reglazing water. Inspite of all these defects, however, it may be pointed out that the majority of the headless and peeled and deveined fresh frozen prawns manufactured in the country lie well within the limits set for bacterial counts of frozen fishery products. Total bacterial count supplemented by data on fecal indicator organisms give a true picture of the sanitary conditions under which the products are prepared.

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2 Fitzgerald, G. A., *Food Industr.* 19: 623 (1947)

TABLE — VII

THE EFFECT OF BACTERIAL LOAD OF WATER, ICE, VESSELS ETC. USED FOR PROCESSING ON THE CHANGES IN BACTERIAL COUNT* OF THE RAW MATERIAL

Sl. No.	Description of sample	Stage of processing: Raw material	Before going into freezer	after freezing	Tap Water	Stored water	Glazing water	Ice	Freezing tray	Table surface	Tray	Al basin
1	Kara headless	7.9×10^5	1.4×10^6	6.1×10^5	440	1050	27,500	6950	5.2×10^6	2.5×10^6	2.2×10^6	
2	Naran P & D backwater	3.5×10^5	5.8×10^5	4.1×10^5	440	4050	25,850		$5\ 2\times10^6$	2.5×10^6	2.2×10^6	
3	White P & D 111—130	1.0×10^6	1.9×10^6	2.0×10^6	8650	4150	41,000		1.6×10^7	3.4×10^8	3.5×10^6	
4	Sea naran headless 26—30	3.4×10^6	2.5×10^6	1.9×10^5	8650	4150	43,000		1.6×10^7	2.4×10^6	$3\ 5\times10^6$	
5	Sea Naran P & D 31—35	8.6×10^6	2.9×10^6	4.8×10^5	59000	845000	49500	50	3.8×10^7	1.2×10^5	1.5×10^7	
6	River naran P & D 91—110	1.1×10^6	1.3×10^5	2.6×10^5	59000	845000	49500	50	3.8×10^7	1.2×10^5	1.5×10^7	
7	Poovalan P & D 130 up	4.2×10^5	3.6×10^5	2.2×10^5	610	3200000	42000		1.0×10^7	1.2×10^7	3.0×10^7	4.5×10^6
8	Sea naran headless 21—25	3.7×10^5	2.7×10^5	3.4×10^5	610	3200000	42000		1.0×10^7	1.2×10^7	3.0×10^7	4.5×10^6
9	White P & D	2.8×10^6	4.99×10^5	1.1×10^6	290				3.7×10^6	7.5×10^5		
10	White P & D 51—60	7.7×10^5	3.3×10^5	6.7×10^5	575		4300		4.8×10^6	1.3×10^7		2.6×10^7
11	Poovalan peeled and cooked 150—300	3.1×10^5	2.4×10^5	6.1×10^5	575		4300		4.8×10^6	1.3×10^7		2.6×10^7
12	White P & D 91—110	2.4×10^6	2.4×10^6	1.8×10^6	8280		15250		4.1×10^6	5.9×10^7		3.3×10^6
13	CP 300—500 Poovalan	6.6×10^5	7.2×10^5	1.0×10^6	8280		15250		4.1×10^6	5.9×10^7		3.3×10^6
14	Poovalan P & D 110 up	5.0×10^6	3.4×10^6	5.3×10^5	90		78			2.2×10^6	1.1×10^5	3.2×10^5
15	poovalan P & D cooked	1.8×10^4	9.5×10^3	$6\ 2\times10^3$	90		78			2.2×10^6	1.9×10^4	3.2×10^5
16	Kazhanthan P & D 61—70	1.2×10^7	1.3×10^6	1.3×10^5	230	1000	10			2.5×10^6	6.5×10^5	3.7×10^4
17	Naran headless 21—25	3.0×10^6	5.5×10^6	5.5×10^5	230	1000	10			2.5×10^6	5.0×10^5	3.7×10^4
18	Naran P & D	3.7×10^6	7.8×10^5	1.9×10^5	3500		50	24550				
19	White P & D 131 up	6.6×10^5	8.3×10^5	2.8×10^6	63			13000				
20	River naran P & D 81—100	3.7×10^5	2.6×10^5	2.8×10^5	355	121509	9650		3.95×10^5			1.0×10^7
21	River naran P & D cooked	5.3×10^4	1.0×10^5	4.9×10^5	355	121500	9650		2.6×10^5			3.0×10^7
22	Sea naran P & D 31—40	6.8×10^5	5.6×10^5	3.3×10^5	63	510000	4500		2.1×10^6	7.1×10^7		3.0×10^7
23	Sea naran P & D 41—50	4.1×10^7	1.0×10^5	4.1×10^5	63	510000	4500		3.7×10^5	7.1×10^7		3.0×10^5
24	Sea naran P & D	9.1×10^5	1.99×10^5	6.3×10^4	152		9650		6.4×10^5	2.6×10^7	5.0×10^6	
25	Kazhanthan P & D	1.6×10^5	...	5.3×10^4	152		9650		6.4×10^5	2.6×10^7	8.0×10^6	

* Count expressed as the number of organisms per gram of material.

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Discussion

Dr. M. V. Rajgopal said that it is disturbing to note that in cooked and peeled frozen prawns the bacterial count is very high especially in view of the very high standards set by importing countries.

Dr. V. K. Pillai informed that the results reported in the paper cover the period 1960-63. Since then the hygiene in factories has considerably improved with the introduction of the voluntary preshipment inspection scheme as well as the implementation of strict cleaning schedules in both the primary processing centres and processing factories. The total bacterial plate counts of this type of pack is found to be within limits in more than 90% of the samples examined. Dr. Pillai, however, struck a note warning against the recent tendency in the industry to decentralize processing work which has introduced an additional difficulty. Many of the primary processing centres are situated in places where the sanitary condition is often very poor and this may lead to contamination of the material by faecal organisms. He advocated the entire processing being carried out in central plants as far as possible.

Thereupon the Chairman pointed out that the present system of decentralized work has come to stay for two reasons: (1) the labour problem (2) most of the plants were designed for small-scale operations in the beginning and do not have sufficient room for all the different stages of processing and packing. In order to produce more or to expand the activities, which are the needs of the day, the processors are therefore forced to resort to decentralization. At the present stage of expansion centralization would be difficult and even impossible. He appealed to the research scientists to find out ways and means to produce top quality products under the present circumstances.

Dr. Pillai stated that steps have already been taken in this direction and the Institute makes a regular survey of the Primary Processing Centres and offers technical advice and practical demonstration in the matter of improving the sanitary conditions, the quality of water and ice and in the treatment of raw material. However he emphasised the fact that at least in the case of cooked frozen prawns the entire processing should be carried out in the factories as these are subject to stricter bacteriological standards. There was general agreement to this view, and in the discussion that followed Shri N. J. Chacko stated that in some of the Government Plants, where several processing concerns are at work, there will not be more than 100 sq. ft. of space for a party to carry out the entire operation and therefore it is impossible to carry out the recommendation in Government plants.

Shri John P. George pointed out that the peeling and grading of prawns are done in outlying Depots by contractors employed by the factory owners. He suggested that they should be made responsible to supply only good material to the factory. The factory will bear full responsibility for the quality of the material after it has been accepted in the factory. Having checks at all places of production is impossible, he further said, and suggested that the factory should be made responsible for the quality of the raw material at the plant.

There was a suggestion that government inspectors should test the raw material before purchase. To this suggestion Shri G. N. Mitra said that it is difficult or rather impossible for Government inspectors to check the raw material as it comes to the factory unless adequate preventive measures have been taken from the very beginning. Shri Mitra added that the Government inspectors can examine only the end product and the factory owners must see that all measures are taken to ensure its quality. The problem of avoiding contamination before the material reaches the factory has to be solved by the industry. He further said that this type of decentralization in processing work as obtained — here was unknown elsewhere in the world.

The Chairman agreed that the best solution to avoid contamination was to do the entire processing under one roof. But he said that there are certain practical difficulties under the present circumstances. He pointed out that lakhs of rupees have been spent for constructing the present factories, which do not have adequate room for all the operations, and there is no question of removing them as it will be a national loss. The best thing that can be done to expand production and increase exports is to get partly-processed material. He emphasised the need for having standard designs for the Depots where the preliminary processing is done. There should be well defined standards both for the Depots and for the factories. He further said that the unsatisfactory conditions which existed in the Depots a few years ago have changed and the industry is getting modernised.

Shri John P. George said that it will require very large area to accommodate all those who process the material inside the factory.

Shri Mitra agreed that these were important difficulties which mitigated against having all the operations in one and the same Plant.

Shri Gopinathan Pillai suggested that since the cooked and peeled prawns tend to have high standard plate counts, they should be processed entirely in the factory. Shri John P. George said that in view of the fact that processing is partly done in the primary processing centres and partly in the factories inspection of the products by Government agencies should be instituted at all sectors.

Shri Mitra repeated that the control of the quality is the responsibility of the Processors and that Government will come in only at the last stage of production to check whether what is sent out from the factory is of acceptable quality.

The Chairman also agreed that the ultimate responsibility for the quality of the product should be with the processor. He said that Government inspection may not be practicable at the primary processing centres. With proper sanitary conditions maintained in the Depots and in course of transport of the material to the Factories the semi-processed goods should arrive in the Factories in excellent condition.

Shri Mitra pointed out that as a general policy, Government likes the factories to be scattered rather than be concentrated at certain places, but of course this applies to certain industries and not to all.

Shri Mitra asked how faecal contamination occurs in the product. Dr. V. K. Pillai explained that it happens through flies, from unclean surfaces and by the use of polluted water for washing purposes.

Dr. Pillai added that the data collected on nearly a thousand samples of frozen products collected over a period of one year from September 1963 were not considered in the paper under discussion. Those data relate to the period when the voluntary preshipment inspection has been in operation which incidentally indicate that there has been a great deal of improvement lately due to the use of chlorinated water for glazing and other hygenic measures.

Shri Mitra referred to the reported shortage of ice and wished to know whether the fishing boats carried ice with them.

Shri Madhavan Nayar said that there is a heavy scarcity of ice and that it is continuous throughout the year, especially when heavy catches are obtained and that the Industry has requested the Government to install a large ice plant at Cochin.

Shri Mitra informed that the Government will be prepared to sanction the funds for putting up an ice plant provided details of its capacity and location are agreed upon.