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The Organic Solid Residues of Fish Processing Industries in Santa Catarina Brazil: Production Scenaries and Technologies

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ABSTRACT

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This document aims to characterize quantitative and qualitatively the organic solid residues produced by the fish processing industry in Itajaí and Navegantes cities Santa Catarina State, Brazil. According to 73% of the 22 companies interviewed, the fish processing reaches an average of 60,000 t/year, generating approximately 30,000 t/year of residues. Of these industries, 68% declared that their residues are sent to fish flour industries, 23% of industries sent their residues to the city landfill, and 9% threw their residues directly into the Itajaí-Açú river, causing a significant impact on that environment. Such residues could be a rich nutritional source of food for humans and animals, once the average protein content, in dry matter, for the residue and fish flour are high (53.6% and 58.6% respectively), as well lipids (20.1% and 11.1%). Considering that 49% of the analyzed residues was within the limits established to *Staphylococcus aureus* and 58% to fecal coliforms, there would be a volume between 14,700 and 17,400 tons/year of residues able to be turned into by-products that require good sanitary quality. The purpose of this study was to show the real potential to transform fish residues into by-products, since sanitary quality required was maintained. In this sense, applying industrial rates to 6 seafood categories, global scenaries of residues generation were also predicted. These actions correlated to Corporate Social-Environmental Responsibility Programme, can contribute to the fishing sector and improve the social and environmental quality in coastal areas, implementing fishery sustainability principles and ensuring the Food Security Programs like “Fome Zero", from Brazilian Government.

ADITIONAL INDEX WORDS: *Fishery industry, seafood by-products, corporate social responsibility.*

INTRODUCTION

Daily fish processing industries generate significant amount of organic solid residues that are not often used in Brazil due to the restricted knowledge, on technological and sanitary procedures for it recovery, by the fishing sector and governmental agencies, besides the lack of Public Politics to promote and support these actions.

This research was carried out to evaluate the generating process and the flow of the discarded residues for fish processing industries from Itajaí and Navegantes cities, center-northern coast of Santa Catarina State (STORI, 2000). The industry of fish products represents 30% of Itajaí industrial park, employing people in the fishing, shipbuilding and provision industry (AMFRI, 1999). Including Navegantes city, it is the fourth largest fish harvesting area of Latin America, with prominence to the several fish factories that export their products (AMFRI, *op.cit*.). These industries compound the largest fishing industrial complex in Brazil, receiving 93% of the fish harvested and landed in Santa Catarina State (IBAMA/CEPSUL, 1999), responsible for 21,2% of the national capture between 1980 and 1994 (PAIVA, 1997).

Concerning annual variations in the fishing landings, an oscillation is expected in the fish processing and consequently in the generation of residues. Yearly variations are verified in the historical series of fish landings in Santa Catarina between 1980 and 1997, in an order of up to 60.000 tons (IBAMA/CEPSUL, 1993 and IBAMA/CEPSUL, 1999). The landings in the area of Itajaí presents values relatively stable according with the fishing statistics published by ICEPA (1998), with a mean estimate of 96.676 t/year and coefficient of variation of 5,6%.

With the purpose to verify the viability of the implementation of a Solid Residue Management System for the fishing sector, it was quantified and qualified the monthly discarded residue by this industrial sector, with prominence to the more representative fish categories in the processing. It was proposed in this research, therefore, to base guidelines for the improvement of the sanitary quality of the raw material in the companies (appropriate forms of manipulation and storage) as requirement for the rational recovery of residues and by-product production.

METHODS

The universe of this study was formed by all of the industries of fish processing and fish flour industries from Itajaí and Navegantes. These industries were mapped in scale 1:10.000, to simplify the visitation process to the production lines and the application of companies characterization inquiry as regards: time of performance, maximum production capacity, main products, residues generation processes and final fates, knowledge about residues recovery technologies, and opinions and interests in a Solid Residue Management System. A survey/table was applied to obtain the mean values of fish species monthly processed. All the collections of data and samples were done between August of 1999 and November of 2000 and the microbiological examination was executed during 2001.

After the determination of the monthly variability in the processing, an analysis was proceeded by fish categories (the most representative species). These categories represent a species or a grouping of them, in agreement with the selection degree and aggregation at the moment of the landing. The categories definition agrees with the way that the companies join species in the processing lines and, consequently, as the

generated residues are joined. This way, the six more representative fish categories in the global processing (sardines, tunas, weakfish, whitemouth croaker, argentine croaker and shrimps) were selected for analysis. Specific income coefficients were applied for each production line and for each fish category to quantify the indeed generated residue. From these determinations, global sceneries of residues generation were established for each production line, being supposed, for effect of these calculations, that the whole volume of that fish species was allocated for a single production line, in the sense of evaluate the maximum potential of annual production of that residue type.

In the analyses of centesimal composition of fat (continuous flow ether extraction), proteins (method Kjeldahl) and humidity (gravimetric), samples from the categories: sardines, tunas, weakfish, argentine croaker and shrimps were used.

In order to evaluate the sanitary quality of these residues, companies were selected among those generating residues with potential for elaboration of by-products (high volume and nutritional quality), including fish of dark musculature (sardines and tunas) and fish of white musculature (weakfish, argentine croaker and hake). The samples were collected with sterilized gloves, conditioned in sterile plastic sacks and transported in thermal boxes for the microbiological analysis (APHA, 1992): counting of total heterotrophic bacteria, counting of anaerobics and most probable number of fecal coliforms, most probable number of total coliforms, most probable number of *Enterococcus*, counting of *Staphylococcus aureus*, presence or absence of *Salmonella*. In that way, it tried to fit these residues in the limits established for consumption (Edict N.01 of DINAL/MS 1987). Comparisons between the different types of collected residues were done using the nonparametric statistical Test U of Mann-Whitney.

RESULTS

Global Analysis of Fish Processing

Twenty two industries of fish processing were identified, 11 of wich were located in Itajaí and 11 in Navegantes. In agreement with data supplied by 73% of the interviewed companies, the processing represents a global mean value of 58.924,8 t/year of fish. The industries have a maximum production capacity of 570 t/day, what would correspond to an annual potential production of approximately 181.000 t. This amount extrapolates in three times the annual mean processing calculated, demonstrating that the installed capacity is evaluated for the intensive work in the peak of the harvests of the most abundant fish, staying idle during most of the year. The global processing of fish in time is shown in Figure 1, which is relatively stable during the year in function of the constant entrance of raw material to the industries.

High amount of processing can be observed in the autumn (March, April and May), when the fisheries of sardine and tuna are more expressive than the fisheries of other representative categories: weakfish, whitemouth croaker, argentine croaker, brazilian cod and chub mackerel. On the other hand, a less

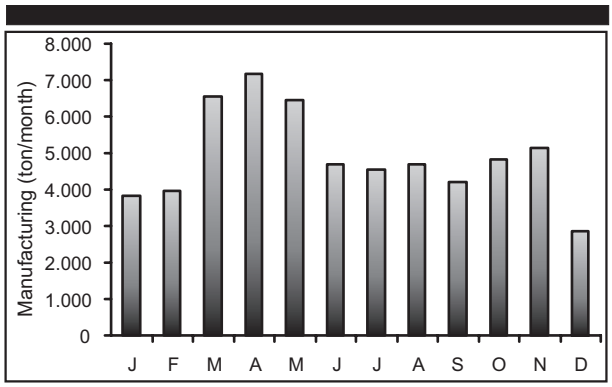

Figure 1. Averaged monthly fish processing in the 22 industries from Itajaí and Navegantes - SC.

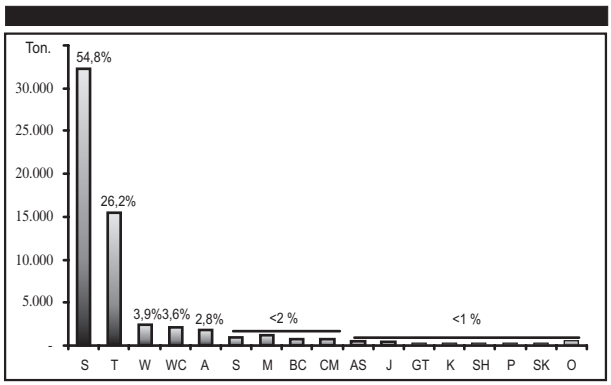

Figure 2. Participation in weight of the main items in the lines of processing of the industries from Itajaí and Navegantes (total of 58.925 ton processed). **S** (sardine), **T** (tunids), **W** (smouth weakfish), **WC** (whitemouth croaker), **SH** (shrimp), **M** (mixture), **BC** (brazilian cod), **CM** (chub mackerel), **AS** (atlantic searobin), **J** (jamaica weakfish), **GT** (gray triggerfish), **K** (southern kingfish), **SH** (shark), **P** (plaice), **SK** (skate), **O** (others).

intense processing was observed in the months of December to February, related to the prohibition time for sardine harvest, fish that contributes with 55% of the global mean processing, following by the tuna with 26% (Figure 2). The existence of other 14 fish categories composing, together with the two more abundant, about 99,2% of the global annual mean processing (58.924,8 t), is also evidenced (Figure 2). To apply the mean tax of use of 50% on this value, the global generation mean of residues would be around 29 thousand t/year. These values would be slightly underestimated, because some companies have not supplied the processing values.

In agreement with the current uses of the residues analysis declared by the companies, it was possible to observe that 68% of the industries sent direct its residues to the fish flour industries, 23% of the industries direct the residues to the landfill and 9% spills it directly in Itajaí-Açú river, what constitutes a serious environmental impact.

Fish Categories Processing Analysis

Starting from the applied survey/table, in which 73% of the companies inserted monthly mean values of processing for fish species, were draw the processing curves for each category (Figure 3) and described as following:

1) Sardines (contained Clupeidae: *Opisthonema oglinum* and *Sardinella brasiliensis*): It is possible to see that the processing of sardines was relatively stable during the year, presenting a maximum value of 4.300 t. in the month of April and monthly average of approximately 3.200 t. In the summer (time of the fishery prohibition - Edict IBAMA N° 3, of January 31, 1997) the processing reaches about 1.000 t, the verified production is due to the raw material imported (Venezuela, Morocco, Mexico and other countries). It was settled down an annual mean production of 32.268 t of sardines in this period, distributed among the lines of gutted production and flattened.

2) Tunas (contained Scombridae: *Thunnus obesus, Thunnus alalunga, Thunnus albacares, Auxis thazard*, with the prevalence of *Katsuwonus pelamis*): The curve of projected mean processing demonstrated high production of January to April with a maximum of 2.266 t the month of February, periods related to the elevation of the water temperature and occurrence of the resource in the area. Soon afterwards, the production decreases in the cold months, being around 850 monthly tons, from June to November. It was settled down an annual mean production of 15.450 t of Scombridae distributed between the lines of gutted production and canned loins.

3) Weakfish (contained Sciaenidae: *Cynoscion leiarchus, Cynoscion striatus* and *Macrodon ancylodon*): It is visualized

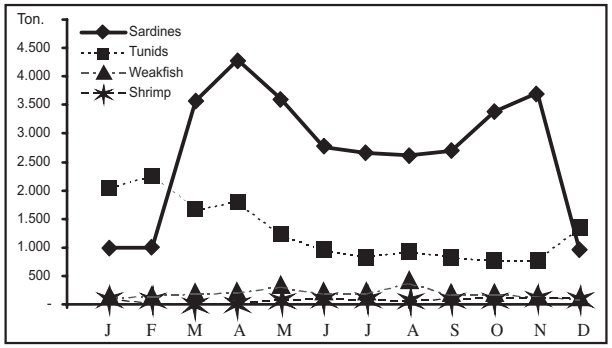

Figure 3: Averaged monthly processing mean of the six more abundant fish categories: sardines, tunas, weakfish, whitemouth croaker, argentine croaker and shrimps. The letters in abciss refer to months.

that the processing of obtaining weakfish has two different peaks, 316 t (in the month of May related to a larger entrance of Cynoscion leiarchus) and 382 t in the month of August (related to the predominance of C. *striatus* and of *M. ancylodon*). A production average was observed around 190 t in the remaining of the period. It was settled down an annual mean production of 2.270 t of weakfish distributed in the lines of gutted production, flattened and filleted.

4) Whitemouth croaker: this category corresponds to Sciaenidae, *Micropogonias furnieri*. The curve of projected mean processing showed a maximum in the month of May with 375 t, followed by a fall in the month of June, increasing in approximately 50 tons for the two following months, and presenting an average around 120 t for the other months of the year. It was settled down an annual mean production of 2.125 t of whitemouth croaker distributed in the lines of gutted production, chopped, flattened and filleting.

5) Argentine croaker: this category corresponds to Sciaenidae, *Umbrina canosai*. The processing mean annual projected showed the maximum of the production in the month of May with 305 t, followed by a decrease in the month of June, starting from which the production decreases smoothly until stabilizing around the 100 monthly tons. It was settled down an annual mean production of 1.661 t of argentine croaker distributed in the lines of gutted production, chopped, flattened and filleting.

6) Shrimps (contained Penaeidae: *Artemesia longinaris, Penaeus schimitti, Penaeus paulensis, Penaeus brasiliensis, Pleoticus muelleri* and *Xiphopenaeus kroyeri*): The curve of projected mean processing presents the lowest productions between February and April. Only 15 t on average are processed in March, due to the fishery prohibition of most of the species (Edict N° 21 of February 11, 1999). In the subsequent months an accentuated elevation of the production was observed, reaching the maximum in the month of October (average of 125 t). It was settled down an annual mean production of 983 t of shrimp distributed in the production lines of whole peeled shrimp or headless.

Production Lines Analysis

In a general way, the fish are classified by size and directed to the production lines that look for a final product to attribute them a larger use in relation to the size of the raw fish. The production lines are:

- Fishes in Filets or Meat: retreat of the fish's head, gut, fins, skin together with the scales and retreat of the number spine, characterized by the great amount of muscle adhered to the residues (carcass). Mean income coefficient between 30 and 45%;
- Flattened Fishes: fish is opened in belly, heads, gut, skin, scales and fins are removed. Mean income coefficient between 43 and 52%;
- Fishes in Pieces: the fish is cut in proportional pieces to its height. Heads, guts, scales and fins are discarded. Mean income coefficient between 54 and 77%;
- Gutted fish: the guts and the scales of the fish are removed, could be removed the head. Mean income coefficient among 90 to 41%;
- Mollusks: gutted and cut in rings. Guts and shell are discarded. Mean income coefficient between 30 and 85%;
- Crustaceans: headless or totally peeled. Mean income coefficient between 65 and 37%.

Chemical Analysis

The analyses of the residues from the most founded fishes in processing industries results in compositions similar to those found for the fish filets in general. In the samples of residues of sardines, they stood out ventral keels of O. *oglinum*, with contents of 13,3% and 16,9% in proteins and fat respectively. Samples of head and fin flow presented high content of proteins (17,4% for *O. oglinum* and 14,4% for to *S. brasiliensis).*

In the samples of residues from tunas stands out cooked heads, dark musculature associated to the spines and skin after cooking and dehydrated gut of *K. pelamis.* These shows a fat content relatively low: 6,9%; 5,5% and 9,6% respectively. On the other hand, the contents of proteins obtained were among the highest: 18,8%; 22,8% and 61,1% respectively.

Among the residues of weakfish evaluated (C. *leiarchus* and *C. striatus*), stood out the spine samples with muscle adhered with content protein around 15,5% and fat content around 7,0%.

In the whitemouth croaker residues (*M. furnieri*), stood out the head with 10,8% in fat content and 14,1% in protein content and the preopercular bones, with fat content of 3,3% and 19% in protein content .

The peels of the shrimp *Artemesia longinaris* demonstrated low content of fat and protein (0,3% and 5,3% respectively).

Microbiological Analysis

In a general way, the residues sampled showed a high degree of contaminants, as it can be observed in the Table 1. Many tests extrapolated the sensibility of the method, not being possible to evaluate the exact number of microorganisms in the samples. On the other hand, the absence of *Salmonella* in the samples indicates the potential of these residues as raw material.

The Test U of Mann-Whitney didn't point significant difference between the residues of the processing of the sardine and of the tuna, both with high microbial numbers. However, the test showed differences in the residues of the tuna and sardina processing in relation to the residues of the processing of white musculature fishes (weakfish, whitemouth croaker and hake). Such verification demonstrates that residues of white musculature fish have a superior sanitary quality in relation to that found for sardine and tuna residues, mainly related to analyses of *Staphylococcus aureus* and *Enterococcus* (Table 1).

In agreement with the Edict N° 1 of DINAL/MS (1987), the limit recommended for consumption in natural of fecal coliforms is 100 MPN/g and for *Staphylococcus aureus* it is 1.000 FCU/g. In agreement with these patterns, about 58% of the collected residues would be able for consumption as the fecal coliforms and 50% for S. *aureus* (Table 1).

Residues Generation Scenaries

To estimate the generation potential of the several types of residues from the fish processing industries, were established production sceneries (Table 2) for the several categories of residues, which are described as follow:

1) Sardines: the annual mean production of 32.269 t was allocated in the two possible sceneries of residues generation for this category: gutted line and flat line. The mean income coefficient in the gutting for sardine, of 65%, implicates in a generation of 35% of residues, in a scenery of 11.293 t of residues generated a year. Whereas, the line of flat sardine, have

a income coefficient of 52% that implicate in a generation of 47,8% of residues, with an established scenery of 15.424 t/year. In these residues the mean contents of fat and proteins were, respectively, 7,5 and 16,2%. Of the three sardine residues samples evaluated for microbiological contamination, just one was framed below the established limits for consumption in fecal coliforms and S. *aureus.*

2) Tunas: the annual mean production of 15.450 t was allocated in two sceneries of residues generation: gutted line and line of cooked loins for canning. The mean coefficient of use in the gutting for tuna is about 90%, implicating in a prodution of 10% of residues, in a scenery of 1.545 t/year. Whereas the production of loins, having presented a mean income coefficient of 42%, implicates in a 58% of residues prodution, giving a scenery of 8.916 t/year. The fat content verified for this residue was of 7,3%, with prominence for the high content of proteins (34,2%). Of the three samples of residues of tunas analyzed for microbiological contamination, two were framed below the established limits for fecal coliforms, however no one framed below the limits for S. *aureus.*

3) Weakfish: the annual mean production of 2.270 t was allocated in three sceneries of residues generation: gutted line, flattened and filleting. The mean income coefficients were positioned between 44 and 57%, implicating therefore in a generation from 43 to 57% of residues, generating production scenery of about 1.000 t/year. The fat contents and of proteins obtained on average for this category were, respectively, 6,5% and 16%. Of the three samples evaluated for microbiological contamination, two samples came below the established limits for fecal coliforms, and the three samples were framed below the established limits for S. *aureus.*

4) Weakfish: the annual mean production of 2.124 t was allocated in four sceneries of residues generation, to know: gutted lines, chopped, flat and filleting. With mean income coefficients varying between 35 and 55% in function of the production line and with consequent amounts between 45 and 65%, the volumes of residues of this category, independent of the production line, are locate between 950 and 1.400 t/year. The mean content of fat obtained for this category was 7,1%, while the one of proteins was of 16,6%. This category was not analyzed for microbiology examination.

5) Whitemouth croaker: the annual mean production of 1.661 t was allocated in four sceneries of generation of residues: gutted lines, chopped, flat and filleting. The mean income coefficient for whitemouth croaker, was between 34 and 55%, generated production scenery between 747 and 1.105 t of residues a year, depending on the production line (filleting always with larger productions of residues). This category was not evaluated in the chemical analysis. Two whitemouth croaker samples were evaluated microbiological examination, of which just a sample was inside of the established limits for consumption in fecal coliforms; however, both are framed inside of the established limits for S. *aureus.*

6) Shrimps: the annual mean production of 983 t was allocated in two sceneries of residues generation: line of whole peeled shrimp or headless. The mean income coefficient for peeled shrimp, of 53,2%, implicates in a generation of 46,8% of residues: scenery of 460 t/year. The mean coefficient of use for headless shrimp was of 63%, what implicated in a generation of 37% of residues: scenery of 363 t/year. Low contents of fat and proteins were verified in residues of A. *longinaris*: 0,26% and 5,28%, respectively. This category was not analyzed for microbiology.

DISCUSSIONS

As highlighted by this study, the sector of fish processing was dominated, in the time of this work, by 22 companies. The annual mean processing of fish is about 60.000 t. Although most of the companies have been interviewed (including the totality of the largest companies of fish processing), this value should be slightly underestimated by the non-inclusion of 27% of the companies. This amount corresponds to 61% of the total landings in the area of Itajaí/Navegantes (CEPSUL: 96.676 t), which could produce a volume corresponding of 30.000 t of residues a year.

It was possible to visualize the types, amounts and qualities of the generated residues. It is stood out that these calculations had exploratory character, once that exact values were difficult of being obtained due to the inexistence of an updated historical registration in most of the interviewed industries. These values can be altered by environmental and economical variables, as: times of fisheries prohibition; unpredictability of the capture (population variation and reflex of the overexplotation); disputes of the market; differences between the size classes and the taxes of use, in their respective production lines etc.

The six main fish categories processed in the area are, in order of processed volume: sardines (54,8%), tunas (26,2%), weakfish (3,9%), whitemouth croaker (3,6%), argentine croaker (2,8%) and shrimps (1,7%). The sum of the residues generated, if each category was allocated in the line of larger residues generation, would be of 28.568,8 t/year.

Moreover, the evaluated residues could serve as rich nutritional source, once the fat contents were between 6,45% and 7,54% and the protein contents 15,97% and 34,22%. However, if the content of proteins of the tuna residues stimulates its use, the level of contamination restricts it, so that, for its use, would be imperative a change in the lines of production and/or procedures in the sense of warranting a better sanitary quality.

Residues of white musculature fishes (weakfish, argentine croaker and hake) showed superior sanitary quality to that found for sardines and tunas residues. The absence of *Salmonella* ssp. in the samples shows an optimistic result for the elaboration of by-products. Considering an amount of 30.000 t/year in residues, there would be a mass of 14.700 - 17.400 t/year of capable residues for elaboration of by-products that demand good sanitary quality, and residues with low fat content (surimi and concentrated proteic), once 49% to 58% of the residues came inside of the established limits for the legislation. Still, contaminated residues could be directed to the silage and the fish flour, still standing out other technologies, still very little spread: leather production starting from the skins, quitosana production, production of shark cartilage, production of carbonate of calcium and extraction of polyunsaturated fat acids.

Although the companies don't follow a rigid quality control in the final disposal of these residues, it is already possible to visualize the evaluated residues as a potential resource for the elaboration of high quality by-products.

CONCLUSIONS

There is a real potential of use of the residues, since the companies observe a more cautious manipulation, a better aggregation of the residues in the productive process and appropriate forms of packaging (e.g. use of cold camera), so that the sanitary qualities and the nutritional contents of the residues are conserved, warranting the quality patterns demanded for the elaboration of by-products.

The processing of the residues could reduce the idle capacity of the industrial fishing sector and increase the generation of jobs and income in the companies, stimulating the productivity with environmental quality and for diversifying the market of by-products in opposition to the increase of the capture of fish, whose stocks (in general) already are find over-explored.

The growth of the fishing sector faces a serious difficulty today: the raw fish shortage excels, and the low perspective of increase of it readiness in mean period. Therefore, the use of residues for the production of by-products, connected to a Corporate Social Responsibility Program, could contribute to the invigoration of the fishing sector, with gains for the environment and society. These actions would contemplate

Table 1. *General results of the microbiological analyses.*

Type of Residue *	Total Coliforms (MPN/g)	Fecal Coliforms (MPN/g)	*Enterococcus (MPN/g)*	*Salmonella (25 g)*	*Staphylococcus (UFC/g)*	Total counting (UFC/g)	Counting Anaerobes (UFC/g)
Sardine A	>1.600	>1.600	>1.600	absent	>20.000.000	>2.000.000.000	>20.000.000
Sardine A	>1.600	540	>1.600	absent	19.000.000	>2.000.000.000	20.000.000
Sardine C	23	23	31	absent	145	4.500.000	20.000
Tuna A	>1.600	>1.600	>1.600	absent	20.000	>2.000.000.000	100.000
Tuna C	1.600	41	540	absent	32.450	14.700.000	100.000
Tuna C	>1.600	21	1.600	absent	7.600	11.700.000	< 100.000
Weakfish B	350	110	17	absent	< 100	>2.000.000.000	10.000
Weakfish B	280	4	79	absent	< 100	21.600.000	1.140.000
Weakfish D	1.600	49	33	absent	< 100	27.000.000	2.000
Argentine croaker B	1.600	1.600	70	absent	< 100	1.600.000.000	<10.000
Argentine croaker C	>1.600	31	350	absent	< 100	4.700.000	46.000
Hake D	>1.600	23	94	absent	5.600	>2.000.000.000	390.000

* The letters indicate different industries from where the samples were collected.

directly in the improvement of the environmental quality of the coastal areas (decrease of the movement and burring of residues in landfills), in the implementation of more efficient productive processes (better use of the raw material, use of species of low commercial value), gain social and improvement of the image of the companies in the society (by-products production at low prices, jobs generation, environmental and social marketing) and improvement of the acting of the company (profit enlargement, and conquest of new markets). These actions would incorporate the beginnings of the Industrial Ecology and Eco-efficiency, enlarging the possibility of sustainability of the fishing sector.

A great possibility of social return exists in the production of institutional feeding, as school snack, or feeding hospital, as well as in the interfaces generation with social politics, as Food Security Program "Fome Zero", of the Brazilian government, that it has been receiving the cooperation of several Brazilian industries in the donation of victuals to lacking families. Contrasting with the delay of the Brasilian fishing sector, other food sectors in Brasil, as meat and chicken processing (especially in the south region) had already incorporated the by-products production starting from residues and they have been obtaining excellent economical results, as well as implementing Corporate Social Responsibility Programs.

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Table 2. *Sceneries of generation of residues for fish category and production line.*

Categories (CV)	Mean production (t/year)	GUTTED (41 - 90%)	CHOPPED (54 - 77%)	FLATTENED (43 - 52%)	FILLETED (30 - 45%)	LOIN (30 - 45%)	PEELED (37 - 65%)	Content fat	Content Proteins
SARDINE (41,4%)	32.267,76	11.293,72	—	15.423,99	—	—	—	7,54% (5,03)	16,23% (1,61)
TUNA (16%)	15.452,9	1.545,29	—	—	—	8.916,32	—	7,31% (2,08)	34,22% (23,38)
WEAKFISH (18,1%)	2.270,83	985,54	—	1.094,54	1.278,48	—	—	6,45% (1,97)	15,97% (0,60)
WHITEMOUTH CROAKER (8,5%)	2.124,15	951,62	1.008,97	1.115,18	1.384,95	—	—	7,05% (5,35)	16,55% (3,46)
ARGENTINE CROAKER	1.661,47	747,66	764,28	937,07	1.104,88	—	—	—	—
SHRIMP (42,8%)	983,22	—	—	—	—	—	460,15	0,26% (0,02)	—

CV: flotation of generation of residues, expressed as variation coefficients around the average, tends as base to the flotation of capture of the species between 1990 and 1997 (IBAMA/CEPSUL, 1999) and being considered the generation of residues as function of the capture and of the landing.