Microbial Quality and Safety of Fish and Fishery Waste

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Introduction

Fisheries contributes immensely to global food and nutritional security. FAO estimates that fisheries and aquaculture provide livelihoods to over 10-12% of global population. About 75% of fish resources are used for human consumption globally of the world fish production and substantial part of the fish produced were lost as fish waste discards and various other uses (over 25% rough estimate). Whole waste fish, fish head, viscera, skin, bones, blood, frame liver, gonads, guts, some muscle tissue are the major discard materials and anticipated to generate 32 million tons of waste in the solid waste and wastewater from the processing. Solid waste only represents 20–60 % of the initial raw material.

Internationally enormous efforts have been taken to convert fish waste to wealth considering the facts fish wastes are important source of proteins, lipids and minerals with high biological value i.e., otherwise as secondary raw material for the production of the wealth viz., anti-hypertensers, immuno-modulators, antioxidants, anticoagulants, osteoporosis, arthritis, diabetes, obesity, etc. This can be used in various sectors viz., human nutrition, cosmetology, aquaculture, microbiology, etc., In this diction utilization of fish waste is an important step and reduces the incineration or dumping at sea causing environmental problems.

In the recent past three important strategies are being implemented for the reduction of waste and recovery of marketable products from fish wastes viz., production of fishmeal/oil, hydrolyzed fish wastes (heat, enzymatic and chemical treatments) for fish or pig meal as well as organic fertilizer components/ compost or silage or fermentations. In addition to this due to biotechnological interventions other utilizations are also taken viz., fish oil with higher level of polyunsaturated fatty acids for human consumption, fish skin or cartilage for production of gelatin or chondroitin sulphate useful in food, cosmetic and pharmaceutical sectors.

Among the discards collagen is a rich source found in skin, scales, and bones over 7% of the total body weight of fish. Collagen is a major structural protein of animal origin and constitutes about 30% of total protein which is an insoluble fibrous protein contributes to the unique physiological function of connective tissue. Among the enzymes highly marketed commercially, proteases take the maximum share and collagen or collagen peptide or collagenase has several applications including the food industry. Collagen hydrolysate prepared enzymatically using collagenase enzyme from microbial sources were comparatively better than thermochemically produced with strong alkali and high temperature.

Hence, the fish by-products provide an excellent source for microbial growth used for various metabolites production such as lysine, enzymes (protease, lipase, etc.) having high biotechnological interest (food processing, detergent, textile, pharmaceutical products, medical therapy, etc.).

Products from the fish and fishery waste.

What is equally important is the microbial quality and safety pertaining to the use of the fish and fishery waste as secondary raw material for production of by-products.

1. Fish collagen
2. Fish gelatin
3. Fish hydro chondroitin sulphate
4. Fish silage
5. Fish meal
6. Fish compost
7. Chitin
8. Chitosan
9. Fish media

Heads and viscera are utilized for preparing microbial growth media. Protein hydrolysates obtained by acid, alkali, or enzymatic treatments of raw or defatted by-products were also used as a nitrogen source for protease production.

Pseudomonas aeruginosa MN7 and *Bacillus subtilis* are cultivated in media containing combined heads and viscera powder allowing an acceptable level of protease production.

Rainbow trout "Oncorhynchus mykiss", swordfish *"Xiphias gladius"*, squid *"Loligo vulgaris"* and yellowfin tuna *"Thunnus albacares* for vibrio species *Vibrio anguillarum* and Vibrio splendidus, tuna waste by Bacillus cereus, lipase production by Rhizopus oryzae, alkaline protease production by Bacillus mojavensisA21 was obtained using Sardinella peptone.

Shrimp shell powder (SSP), squid pen powder (SPP), chitin flake of shrimp shell (CFSS), chitin flake of crab shell (CFCS), shrimp and crab shell powder (SCSP) were used as raw material in industries. *Chryseobacterium* sp. TKU014, Bacillus subtilis TKU007, Bacillus sp. TKU004, *Lactobacillus paracasei* subsp *paracasei* TKU010, *Lactobacillus paracasei* subsp paracasei TKU012, *Serratia ureilytica* TKU013, *Bacillus cereus* TKU006, Serratia sp. TKU016 are few species of bacteria used for production of secondary raw material. Ligninolytic enzymes were also produced from bacteria using the waste.

Similarly, wastewater from fish processing industry supplemented with cuttlefish by-products powder was also tested as growth media for microbial growth and protease production by five bacterial species (*Bacillus licheniformis*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Bacillus cereus* BG1, and *Vibrio parahaemolyticus*).

Silage obtained by lactic acid fermentation of shrimp head wastes containing chitin, proteins lipids and minerals was also used as substrate and inducer of β-N-acetylhexosaminidases of *Verticillium lecanii* in submerged fermentations (SF) and solid-state fermentations (SSF). The addition of sucrose or sugar cane pith bagasse reduces the growth time of *V. lecanii*. Interestingly, a mixture of shrimp waste silage and sugar cane pith bagasse in SSF improved significantly the enzyme yield. Chitinous materials from marine sources can be considered as good inducers for microbial chitinase production.

Microbial quality and safety

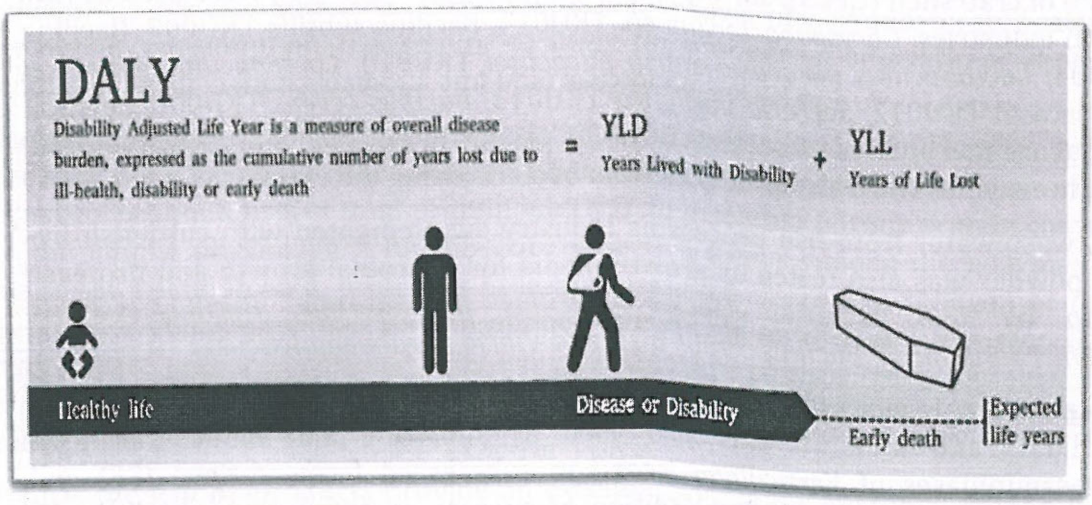
The occurrence of fish and fishery products illness is not evidence of the failure of our safety system. In fact, many of our prevention and control efforts have been and continue to be highly effective. Despite great strides in the area of microbiological safety of fish and fishery products, much remains to be done. In under developed and developing countries of Asia, Africa and Latin American Countries in the absence of good surveillance programs the task is much more complicated especially catering to needs of microbial safety of fish and fishery products of billions of populations.

Fish borne disease outbreaks are defined as the occurrence of 2 or more cases of a similar illness resulting from ingestion of a common fish and fishery products or observed number of cases of a particular disease exceeds the expected number. These can be confirmed (when at least one causal agent is identified) or suspected (based on clinical and epidemiological information). Although most cases are sporadic, these diseases draw attention to themselves due to outbreaks, thorough investigation of which can help in identifying control measures.

Annual burden of food borne diseases in the WHO South-East Asia Region includes more than: • 150 million illness • 175 000 deaths • 12 million DALYs Source: FERG Report 2010

The disability-adjusted life year (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. It was developed in the 1990s as a way of comparing the overall health and life expectancy of different countries.

The DALY is becoming increasingly common in the field of public health and health impact assessment (HIA). It "extends the concept of potential years of life lost due to premature death...to include equivalent years of 'healthy' life lost by virtue of being in state of poor health or disability." In so doing, mortality and morbidity are combined into a single, common metric.



Despite significant success at improving the safety of the fish and fishery products, current science on which safety is based does not sufficiently protect consumers from emerging issues inherent to a complex to fish and fishery products. The evolving characteristics of food, technology, pathogens and consumers make it unlikely the marketplace will be entirely free of dangerous organisms at all times for all consumers. This is the conclusion made in the report, Emerging Microbiological food Safety Issues: Implications for Control in the 21st Century was released today at IFT's International Food Safety and Quality Conference and Expo in Atlanta one and half decades back.

The report, drew upon experts specializing in food borne pathogens and microbial evolution, fish and fishery products borne illness, food production and processing, testing methods and regulatory measures, reveals that diligent adherence to current methods that create and monitor the food supply cannot eliminate the risk of food borne illness. The report also offered the recommendations for providing the greatest possible reduction food safety risks.

Among its seven important issues addressed were:

1. Procedures from farm to table to significantly reduce illness due to mishandling,
2. Processes to recognize and respond to outbreaks and to reduce their scope.
3. Poor habits that make consumers more susceptible to foodborne illness,
4. Education and training recommendations necessary for reducing pathogenic influence at every step
5. From production to consumption (pond to plate/farm to fork
6. Recommendations to enhance monitoring, data generation, and risk assessment. &
7. The current state and future potential of rapidly evolving illness-causing pathogens and other key issues.

To gain the greatest measure of food safety, the report stressed on the necessity of implementing flexible food safety measures so as to utilize as quickly as possible the latest scientific information as it evolves. The report also urged manufacturers, regulatory and public health agencies and allied organizations to develop partnerships to improve risk assessment and food safety management.

Food safety goals must achieve more than end-product probes

The absence of pathogens in final-product testing does not ensure food free of virulent microorganisms, according to a new expert report on food safety issues, and as pathogen contamination decreases this form of testing becomes more deficient. So as today's food safety continues to improve, more emphasis should be placed on monitoring processing capabilities and conditions through the application of science-based food systems.

The microbiological testing of finished food products can be misleading for the following reasons

1. Due to statistical limitations based on the amount of product sampled.

2. The percentage of product contaminated.

3. The uniformity of the contamination distributed throughout the fish and fishery products.

The above-mentioned negative results imply an absence of pathogens in food, the report states, and can cause consumers to assume proper fish and fishery products and handling practices are unnecessary. Instead, the report urges everyone along the farm-to-fork sea food chain to be responsible for an important role in fish and fishery products safety management.

According to Douglas L. Archer of the University of Florida who contributed to IFT report "Current safety evaluations focus on microbes that may or may not be harmful to humans," he added, "For example, some subtypes of *Listeria monocytogenes* found in or on foods may not be associated with food borne illness. Yet their mere detection can be grounds for legal action against the manufacturer and force recalls of food that is unlikely to cause illness in the general population."

The need is for science-based approach called Safety Objectives that would place specific values on public health goals, with reassurances those values are reached at key points along the pond to plate process. Those values would be flexible as hazards and public health goals change, science progresses, and unfettered data sharing improves, allowing for the quickest implementation of new safety improvements as they evolve, and a safer fishery product.

The report urges intentional interaction of public health, regulatory, industrial and consumer agencies, calling the implementation of a flexible, science-based approach involving all these parties "as the best weapon against emerging microbiological food safety issues."

Steps in sea fish and fishery products Safety Management

Fish and fishery products borne illness in India is a major and complex problem that is likely to become a greater problem as we become a more global society where every 5th person walking on this planet is going to be Indian. Nearly 10 million fish and fishery products borne illnesses occur per year in India. To adequately address this complex problem, the need is to develop and implement a well-conceived strategic approach that quickly and accurately identifies hazards, ranks the hazards by level of importance, and identifies approaches for microbial control that have the greatest impact on reducing hazards, including strategies to address emerging hazards that were previously unrecognized.

Policy Development

Scientific research has resulted in significant success in improving sea foods safety, but the current science supporting the safety of our sea food is not sufficient to protect us from all the emerging issues associated with the complexity of the fish and fishery products. As new issues emerge, some will be best addressed through the application of control technologies during sea food production and processing, but others may be best addressed at the consumer level through modification of exposure or susceptibility.

Fish and fishery products safety policies should be developed as part of national initiatives, with input from all stakeholders. In addition, international coordination of fish and fishery products safety efforts should be encouraged. Globalization of the fish and fishery products has contributed to changing patterns of fish and fishery products borne illness, and global fish and fishery products has the potential to introduce pathogens to new geographic areas.

To achieve the maximum benefits, our fish and fishery products safety efforts and policies must be carefully prioritized, both in terms of research and in application of controls. As scientific advances provide a better picture of pathogenicity, the need of the hour is whether to focus the efforts on those pathogens that cause many cases of minor illness or instead focus on those pathogens with the greatest severity, despite the relatively low number of cases. In the move toward making decisions based on risk, the fish and fishery products safety policies need to weigh these issues, and communicate information about risk to all stakeholders, especially the public.

The body of scientific knowledge must be further developed, with the research efforts carefully prioritized to yield the greatest benefit. Fish and fishery products safety and regulatory policies must be based on science and must be applied in a flexible manner to incorporate new information as it becomes available and to implement new technologies quickly. The seafood industry, regulatory agencies and allied professionals should develop partnerships to improve fish and fishery products safety management.

In essence:

Seafood Supply and exports: The amount of exported fish and fishery products has increased significantly, and this trend is likely to continue. Consistent, widespread application of fish and fishery products safety systems, including Hazard Analysis and Critical Control Points systems and good manufacturing (GMP), must be encouraged for international trade.

New Seafood Processing Technologies and Novel fish and fishery products. Scientists continue to be challenged to adequately address all the parameters associated with the introduction of a novel seafood or alternative processing technology. Once developed, new technologies must be appropriately used and regulated to ensure their proper application and the product's safety.

The use of manure as a fish pond fertilization is a significant concern. Methods are needed to reduce the presence of pathogens in manure and to effectively eliminate them before they contaminate the aquatic environment and fish.

Changes in Fish and fishery products Consumption. People's changing dietary patterns affect their risk of fish and fishery products from illness. The control and prevention methods will need to be adapted to these changing dynamics. For example, in India the number of high-end consumers who prefer ready to eat fish and fishery products are more than 300 million which is more or less equivalent to Europe.

At-Risk populations. It is likely that the number of persons at higher risk for fish and fishery products borne disease will continue to increase with time. In addition, there are an increasing number of transplant recipients, people undergoing treatment for cancer, people with AIDS, and others with compromised immune system function.

Pathogen Evolution. Microbial evolution has always happened and will continue to occur. Improved surveillance and new genomic technologies offer the potential to identify new potential fish and fishery products borne pathogens before they cause significant illness. Another hope for the future is a better understanding of how human actions affect fish and fishery products borne pathogens.

Consumer Understanding. Education and risk communication will be necessary to share with consumers our growing knowledge of fish and fishery products safety risks and to encourage behaviour modification, where needed.

Integrated Fish and fishery products Safety System. A farm to- fork or pond to plate table fish and fishery products safety system must involve many interested parties working together toward a common goal. The challenge is to build a system that applies science in a predictable, consistent, and transparent manner to enable harmonization within and between countries. The list of principal symptoms of Bacteria, potential fish and fishery products contamination are provided in table below.

List of bacterial fish and fishery products poisoning, symptoms and Fish and fishery products

Organism	Common Name of Illness	Onset Time After Ingesting	Signs & Symptoms	Duration	Fish and fishery products
Bacillus cereus	*B. cereus* fish and fishery products poisoning	10-16 h	Abdominal cramps, watery diarrhea, nausea	24-48 h	Meats, stews, gravies, vanilla sauce
Campylobacter jejuni	Campylobacteriosis	2-5 days	Diarrhea, cramps, fever, and vomiting; diarrhea may be bloody	2-10 days	Raw and undercooked poultry, unpasteurized milk, contaminated water
Clostridium botulinum	Botulism	12-72 hours	Vomiting, diarrhea, blurred vision, double vision, difficulty in swallowing, muscle weakness. Can result in respiratory failure and death	Variable	Improperly canned fish and fishery products s, especially home-canned vegetables, fermented fish, baked potatoes in aluminum foil
Clostridium perfringens	Perfringens fish and fishery products poisoning	8–16 hours	Intense abdominal cramps, watery diarrhea	Usually 24 hours	Meats, poultry, gravy, dried or precooked fish and fishery products, time and/or temperature-abused fish and fishery products

Cryptosporidium	Intestinal cryptosporidiosis	2-10 days	Diarrhea (usually watery), stomach cramps, upset stomach, slight fever	May be remitting and relapsing over weeks to months	Uncooked fish and fishery products contaminated by an ill fish and fishery products handler after cooking, contaminated drinking water
Cyclospora cayetanensis	Cyclosporiasis	1-14 days, usually at least 1 week	Diarrhea (usually watery), loss of appetite, substantial loss of weight, stomach cramps, nausea, vomiting, fatigue	May be remitting and relapsing over weeks to months	Various types of fresh produce (imported berries, lettuce, basil)
E. coli (Escherichia coli) producing toxin	*E. coli* infection (common cause of "travelers' diarrhea")	1-3 days	Watery diarrhea, abdominal cramps, some vomiting	3-7 or more days	Water or fish and fishery products contaminated with human feces
E. coli O157:H7	Hemorrhagic colitis or *E. coli* O157:H7 infection	1-8 days	Severe (often bloody) diarrhea, abdominal pain and vomiting. Usually, little or no fever is present. More common in children 4 years or younger. Can lead to kidney failure.	5-10 days	Undercooked beef (especially hamburger), unpasteurized milk and juice, raw fruits and vegetables (e.g. sprouts), and contaminated water
Hepatitis A	Hepatitis	28 days average (15-50 days)	Diarrhea, dark urine, jaundice, and flu-like symptoms, i.e., fever, headache, nausea, and abdominal pain	Variable, 2 weeks-3 months	Raw produce, contaminated drinking water, uncooked fish and fishery products and

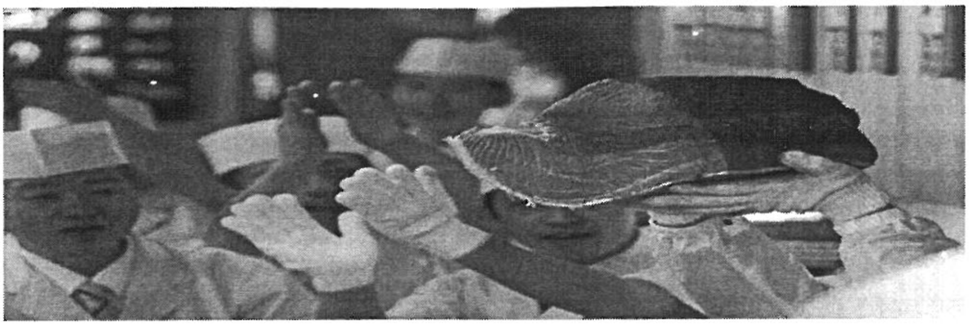
					cooked fish and fishery products that are not reheated after contact with an infected fish and fishery product handler; shellfish from contaminated waters
Listeria monocytogenes	Listeriosis	9-48 h for gastro-intestinal symptoms, 2-6 weeks for invasive disease	Fever, muscle aches, and nausea or diarrhea. Pregnant women may have mild flu-like illness, and infection can lead to premature delivery or stillbirth. The elderly or immunocompromised patients may develop bacteremia or meningitis.	Variable	Unpasteurized milk, soft cheeses made with unpasteurized milk, ready-to-eat deli meats
Noroviruses	Variously called viral gastroenteritis, winter diarrhea, acute non-bacterial gastroenteritis, fish and fishery products poisoning, and fish and fishery products infection	12-48 h	Nausea, vomiting, abdominal cramping, diarrhea, fever, headache. Diarrhea is more prevalent in adults, vomiting more common in children.	12-60 h	Raw produce, contaminated drinking water, uncooked fish and fishery products s and cooked fish and fishery products that are not reheated after contact with an infected fish and fishery products handler; shellfish from contaminated waters
Salmonella	Salmonellosis	6-48 hours	Diarrhea, fever, abdominal cramps, vomiting	4-7 days	Eggs, poultry, meat, unpasteurized milk or juice, cheese, contaminated raw fruits and

					vegetables
Shigella	Shigellosis or Bacillary dysentery	4-7 days	Abdominal cramps, fever, and diarrhea. Stools may contain blood and mucus.	24-48 h	Raw produce, contaminated drinking water, uncooked fish and fishery products s and cooked fish and fishery products that are not reheated after contact with an infected fish and fishery products handler
Staphylococcus aureus	Staphylococcal fish and fishery products poisoning	1-6 hours	Sudden onset of severe nausea and vomiting. Abdominal cramps. Diarrhea and fever may be present.	24-48 hours	Unrefrigerated or improperly refrigerated meats, potato and egg salads, cream pastries
Vibrio parahaemolyticus	*V. parahaemolyticus* infection	4-96 hours	Watery (occasionally bloody) diarrhea, abdominal cramps, nausea, vomiting, fever	2-5 days	Undercooked or raw fish and fishery products, such as shellfish
Vibrio vulnificus	*V. vulnificus* infection	1-7 days	Vomiting, diarrhea, abdominal pain, blood borne infection. Fever, bleeding within the skin, ulcers requiring surgical removal. Can be fatal to persons with liver disease or weakened immune systems.	2-8 days	Undercooked or raw fish and fishery products , such as shellfish (especially oysters)

Need for Quality Improvement in Fish

Costliest Tuna as case study

Kiyomura Co's sushi chefs react to a part of a 222 kg (489 lbs) Bluefin tuna after cutting its meat at the company's sushi restaurant outside Tsukiji fish market in Tokyo January 5, 2013. The tuna was sold nearly for 1.8 million USD and when it converted into local currency what could be cost of whole of 222kg, per/kg and also with 74% meat yield amounting to 164.28kg what could be the cost price per kg in local currency of the participating countries is provided in the Table below.



Costliest Bluefin Tuna sold for 1.8 million USD and when it is converted into local currency what could be cost of whole of 222kg, per/kg and also with 74% meat amounting to 164.28kg and per kg						
S. No	Country (currency)	Local currency to USD	USD to local currency	A 222Kg Bluefin tuna cost	Per Kg out of 222kg	With 74% meat yield when the weight is 164.28 Kg and the cost per/kg
1	Afghanistan (Afghani)	75.97	0.013	136,746,000	615,972.97	**832,395.91**
2	Algeria (Dinar)	118.61	0.0084	213,498,000	961,702.70	1,299,598.25
3	Bangladesh (Bangladeshi Taka)	83.79	0.012	150,822,000	679,378.37	918,078.88
4	Ethiopia Ethiopia Birr	27.93	0.036	50,274,000	226,459.46	305060.68
5	Iraq Iraqi Dinar	1191.7	0.000884	2,145,060,000	9662432.43	13,057,341.12
6	Mynmar (Myanmar Kyat)	1598.1	0.00063	2,876,580,000	130,753,636.36	17,510,226.44
7	Sebia (Sebrbian Dinar)	104	0.0096	187,200,000	843,243.24	**1,139,517.89**
7	Sudan (Sudanese pound)	47.62	0.021	85,716,000	386,108.10	**521,767.71**
8	Tanzania (Tanzania Shilling)	2290.40	0.00044	4,122,720,000	18,570,810.81	**25,095,690.28**

Factors contributing to outbreaks of fish borne disease	
Contributing factors	Percentage
Factors relating to microbial growth	
Storage at ambient (room) temperature	43
Preparation too far in advance of serving	41
Improper warm holding	12
Use of leftovers	5
Extra large quantities prepared	22

Factors contributing to outbreaks of fish borne disease	
Contributing factors	Percentage [a]
Factors relating to microbial survival	
Improper reheating	17
Inadequate cooking	13
Factors relating to contamination	12
Fish and fishery products workers	7
Contaminated raw fish and fishery products s	11
Cross-contamination	7
Inadequate cleaning of equipment	5
Unsafe source	

Fish and fishery products hazards: Perception of the consumer verses epidemiological data		
Case	Perception	Relative importance
Microbial contamination	22	49.9
Nutritional imbalance		49.9
Environmental contaminants	31	0.05
Natural toxins	10	0.05
Fish and fishery products additives	30	0.0005
Others, e.g., packaging materials	7	

Chlorine use in different stages	
Purpose	**In PPM**
Washing for processing	5-10
For making ice	5-10
To disinfect after washing with detergents	100
Washing floors and gutters	500-800
Washing product	10
Washing of boat deck, fish holds and wooden boxes.	1000
Cleaning of fish containers, carrier vans, refrigerated wagons	100
Washing of utensils, processing tables etc	100
Washing of hands	20

Tools for quality improvement

- Empowerment
- Benchmarking
- Kaizen (Continuous improvement approaches)
- 6-Sigma applications
- 5-S A requirement for TQM
- Good manufacturing Practices (GMP)
- Hazard Analysis Critical Control Point (HACCP)

5s good housekeeping

- Sort: take out unnecessary items and dispose
- Systematize: Arrange necessary items in good order
- Sweep: Clean your work place
- Standardize: Standardize the process of sorting, arranging and cleaning
- Self-discipline: Do things spontaneously as a habit.

Evolution of the quality profession

- '50s---Inspection & Conformance to specification
- '60s---Customer requirements or fitness for use
- '70s---Human dimensions of quality (Quality people do quality work)
- '80s---Relationships at the work place (Quality work depends on quality of work life)
- '90s--- partnerships between employees, customers and stakeholders.
- 2010: management of Data, Information and Knowledge

5M's of Quality

- Manpower
- Materials
- Methods
- Machines
- Measurement

5r's of Unquality

- Reject
- Rework
- Return
- Recall
- Regrets

PPM of quality responsibility

- Planning
- Prevention
- Monitoring

DIFFERENT LEVELS OF QUALITY PRACTICE

- LEVEL 1- QUALITY AWARENESS (QAW)
- LEVEL II- QUALITY CONTROL (QC)
- LEVEL III- TOTAL QUALITY CONTROL (TQC)
- LEVEL IV- TOTAL QUALITY MANAGEMENT (TQM)
- LEVEL V-PARTNERSHIPS FOR QUALITY, PRODUCTIVITY AND PROFITABILITY (PQP2)

Principles of Total Quality Management

- A Aim for customer satisfaction
- C Communicate and coordinate all activities
- C Commit and cooperate towards improvement
- E Empower the employees
- P Promote use of problems solving tools
- T Training for quality is forever

Stages in TQM Development

- G Get management commitment
- R Review recorded procedures
- A Assess quality practices
- C Compare records and practice
- E Evaluate results
- O Overview total situation
- F Find areas requiring improvement
- G Get fully involved
- O Out do your own performance
- D Document changes in procedures
- A Assessment, identification and preparation
- M Management, understanding and commitment
- E Energizing for improvement
- N New initiatives, new targets and critical monitoring

Requisites for Total Quality Commitment

- C Customer orientation whether inside or outside the set up
- H Human resource striving for excellence
- A Acquisition of products and process leadership
- M Management leadership for quality
- P Practice quality as a way of life inside and outside work place
- S Sustained quality culture in the company

CARES

- C Communicate management plans for quality
- A Accessibility to one another in the organization
- R Revitalization of problem solving capabilities
- E Embarrassments are avoided if all agree that inspection is not the way to achieve quality
- S Sustain the desire to personally commit to quality

Code of Conduct In Team Meeting

- Co-operate with each other
- Listen to other's ideas
- Keep an open mind
- No personal attacks
- Stick to the facts
- Every one participates
- Be tactful, be honest
- No hidden agendas

Importance of Delivering Both Quality Products And Service

- 68% customers stop purchases due to poor service
- Customers are five times more likely to leave for poor service than poor product quality or high cost
- The average unhappy customer tells nine other people about experience
- When 50 to 75% of the complaints attended to 95% unhappy customers can be saved
- Average happy customer tells five others.

Conclusion

The disposal of wastes generated by fishery processing industries represents an increasing environmental and health problem. However, these by-products have attracted considerable attention as an alternative feedstock and energy source, since they are abundantly available. Various microbes are capable of using these substances as carbon and energy sources beneficial in enzyme production process. A number of such substrates have been tested for the cultivation of microorganisms to produce several enzymes (protease, lipase, chitinases, peroxidases, laccases, oxidases, etc.). This may have numerous advantages for enzyme production process, such as superior productivity, simpler techniques, reduced energy requirements and reduced production costs. Generally, fish waste pre-treatments may be necessary to maximize microbial growth and enzyme production. However, each microbial strain has its own special conditions for maximum enzyme production. Therefore, it is of great significance to optimize the medium composition, taking into consideration the variability of fish waste composition, the nutrient requirements of microbial strain and fermentation parameters (pH, temperature, aeration, agitation, etc.). Nevertheless, the improvements in fish waste technology (pre-treatments, characterization, formulation, etc.) are still necessary before large-scale application of this new strategy can be realized.

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