TECHNOLOGY TRANSFER 2024

KERALA UNIVERSITY OF FISHERIES AND OCEAN STUDIES

KUFOS

PANANGAD, KOCHI

MESSAGE

Kerala University of Fisheries and Ocean Studies (KUFOS), a premier institution dedicated exclusively to education, research, development, and extension in Fisheries, Ocean Sciences, and allied sectors, prioritises the development of innovative technologies to support the state's farmer and fisher communities. These efforts aim to foster economic growth and entrepreneurship development.

This publication showcases a range of technologies, culminating in years of focused research supported by the State Plan Fund. Some of these technologies also result from postgraduate student research projects and a UNDP-funded initiative undertaken during 2017–2022. Each of these technologies is ready for transfer to aspiring entrepreneurs, paving the way for practical applications and societal benefit.

We deeply appreciate the unwavering commitment and sincere efforts of our faculty in driving these advancements.

Vice Chancellor i/c
Kerala University of Fisheries and Ocean Studies
15th November 2024

INTRODUCTION

The Directorate of Research at Kerala University of Fisheries and Ocean Studies (KUFOS) spearheads the University's research initiatives, fostering innovation and addressing emerging needs in fisheries, ocean sciences, and allied sectors. In 2017, with financial backing from the State Plan Fund, KUFOS established Centres of Excellence in key thrust areas to accelerate advancements in these fields. The period 2017–2022 saw remarkable progress, with the development of diverse technologies through faculty-led research, postgraduate projects, and externally funded initiatives.

Key areas of focus included indigenous fish seed production, aquaculture feed formulation, aquatic animal health management, resource conservation, and value-added food product development from underutilized agro-resources. Some of the innovative technologies and techniques developed during this period include:

Aquaculture Innovations:

Seed production of Malabar Dwarf Puffer and Olive Barb.

Backyard Hatchery Technology for Karimeen (Pearl Spot).

Novel feeds such as farm-made feed for Indian major carps, insect-based feed for pangasius, and cashew nut waste-based feed for tilapia.

Value-Added Food Products:

Ready-to-eat products like bilimbi syrup, jackfruit leather, and thermally processed tomato paste.

Low-calorie and nutrient-enriched snacks, including marine fibre-enriched bakery products, multi-millet cookies, nutrient bars, and diet chocolates.

Fish-based innovations like micronutrient-rich fish soup powder (using silver carpet fish) to combat malnutrition.

Fortified products such as fish pasta and noodles, calcium-incorporated gluten-free cookies, shrimp crackers, fish jerky, and seaweed-infused pasta.

Sustainable Processing and Waste Valorization:

Development of gelatin from fish processing waste for applications in products like marshmallows, jellies, and gummy candies.

Secondary processing of fish by-products into value-added items.

Advanced Technologies:

An ultraviolet-assisted vertical recirculatory depuration system for live shellfish, ensuring reduced contamination and extended shelf life in less polluted natural water.

This compilation provides a detailed description of these technologies, each ready for transfer to entrepreneurs looking to innovate in aquaculture, food processing, and allied industries.

15th November 2024

Director of Research

Kerala University of Fisheries and Ocean Studies

CONTENTS

Development of Captive Breeding Technique of *Dawkinsia apsara*

Technology Developed by:

Faculty : Dr. Shyla G
Dr. Rameez Roshan P M
Student team: Sebin Sebastian, Rajanand S
Department of Aquaculture, Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies

Introduction

The increasing demand for indigenous fish species in India's export market is primarily supported by unsustainable wild collection, which jeopardizes the future sustainability of the trade. The reduction in wild fish populations, coupled with a focus on a limited number of high-demand species in Kerala, emphasizes the urgent need for action. To tackle these issues, it is essential to develop standardized seed production techniques, which would alleviate pressure on wild stocks and promote the introduction of new species into the ornamental fish industry, aiding both conservation efforts and trade growth.

Dawkinsia apsara, recently discovered in the genus Dawkinsia and commonly known as Apsara barb, is a brightly coloured schooling fish suitable for aquariums, similar to the Mascara barb

Requirements

Concrete tanks /FRP tanks/ large aquariums/ aerators, filtration system, spawning substrates, nets and accessories, Hormone

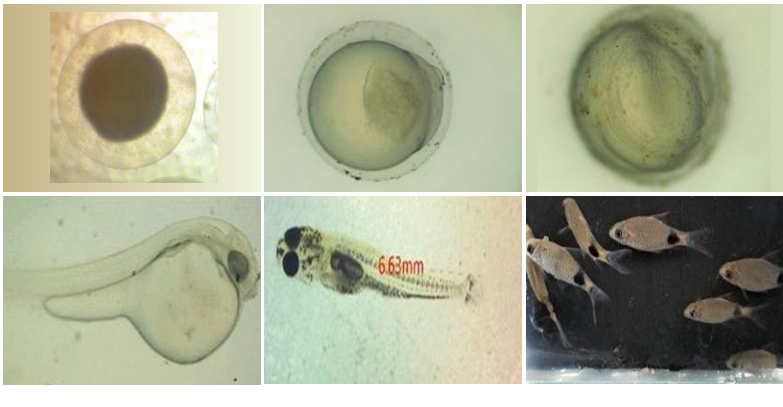
Technology Intervention

The technology intervention involved the use of a varied diet, which included both pelleted and live feeds, to support the reproductive conditioning and health nourishment of the broodstock.

A large, aerated tank equipped with a shower effect and a bottom substrate was provided to simulate a natural breeding environment.

Successful breeding of *Dawkinsia apsara* under captive conditions was achieved using hormone-coated feeds.

Spawning occurred within 12 to 24 hours



Seed production protocol for the Exclamation barb, Dawkinsia exclamatio (Pethiyagoda & Kottelat 2005)

Technology Developed by:

Faculty: Dr. Anvar Ali PH
Student team: Melbin Lal
Department of Fisheries Resource Management, Faculty of Fisheries Sciencea

Introduction

The Exclamation Barb (*Dawkinsia exclamatio*) is a point-endemic freshwater fish species native to the Umayar and Kulathupuzhayar tributaries of the Kallada River within the Shendurney Wildlife Sanctuary, Kerala. Listed as Endangered (EN) on the IUCN Red List, this species faces significant threats due to habitat loss, overexploitation, and its high demand among aquarium hobbyists and traders.

Methodology

I. Brood stock development

Broodstock of ***Dawkinsia exclamatio*** can be maintained in well-planted aquariums and provided with a nutritionally enriched diet comprising egg yolk, milk powder, prawn meat, clam meat, vitamin-mineral supplements, fish oil, and copepod-dominated mixed zooplankton cultured in green water. A domestication period of one month is recommended to enhance the health and reproductive readiness of the broodstock before commencing breeding trials.

II. Sexual Dimorphism and nuptial colouration

Male *Dawkinsia exclamatio* display distinctive nuptial coloration, the formation of tubercles along the snout, and filamentous extensions on the dorsal fin. In contrast, females lack these features, enabling easy differentiation during the breeding process.

III. Breeding Trials

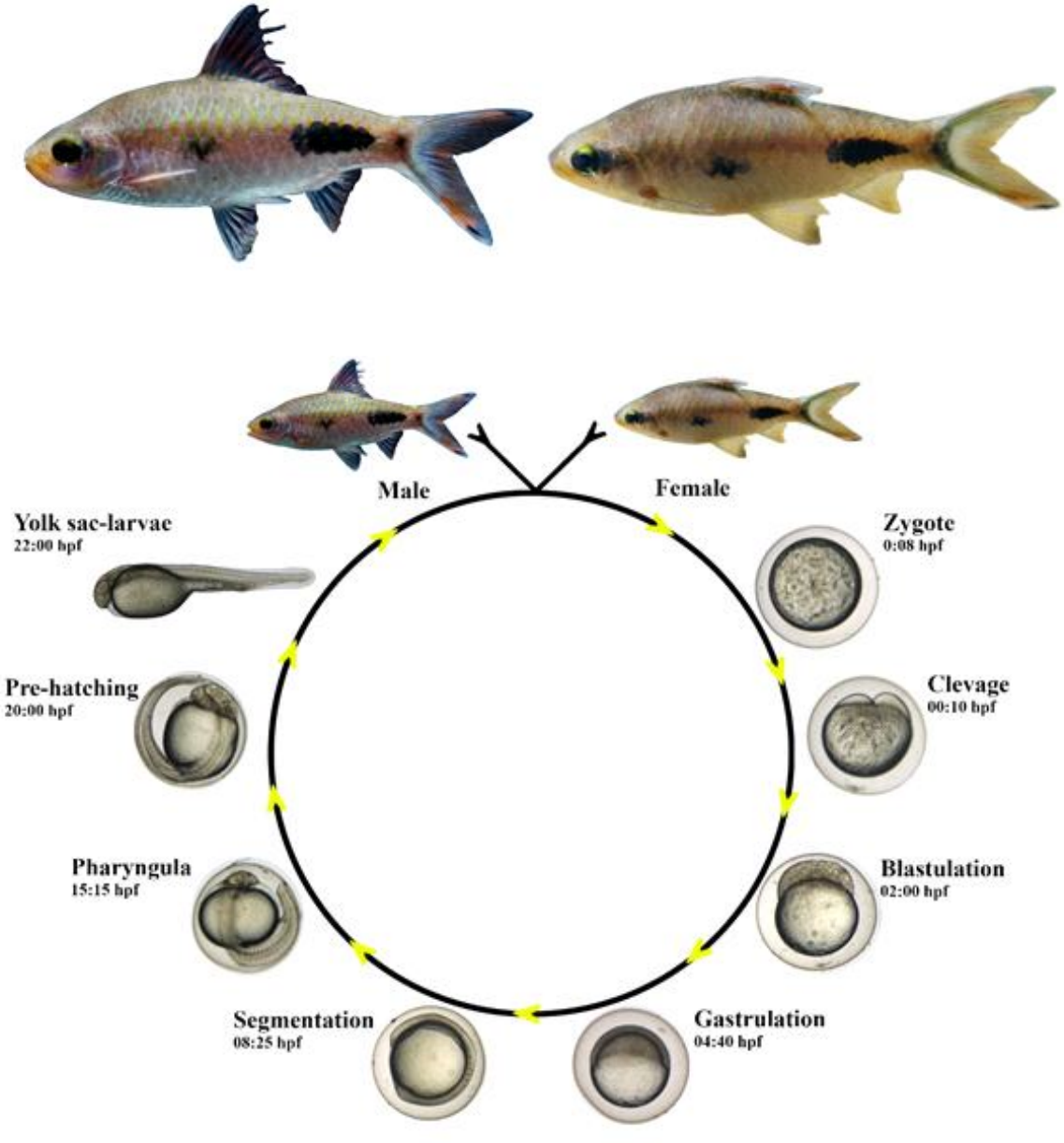
Breeding trials can be conducted in aquarium tanks measuring 1.5 m × 0.5 m × 1 m, furnished with aquatic plants to mimic natural habitats. Broodstock should be anesthetized using clove oil and induced with synthetic gonadotropin-releasing hormone (WOVA-FH™) at a dosage of 0.3 ml/kg body weight. After spawning, brooders must be removed, and the eggs aerated using an adjustable air pump to maintain optimal oxygen levels.

IV. Larval Rearing

Larvae begin hatching approximately 22 hours post-fertilization. By the sixth day, at an average temperature of 26°C, the yolk sac is fully absorbed. At this stage, the larvae can be fed nauplii of freshwater copepods, filtered through a 100 µm mesh plankton net.

V. Potential/ Anticipated Beneficiaries

Educated women entrepreneurs, activity groups under self-help groups, members of Kudumbashree Units, educated youth etc.



Life cycle of the Exclamation barb, *Dawkinsia exclamatio* (Pethiyagoda & Kottelat 2005).

Seed production protocol for the Indigo barb, *Pethia setnai* (Chhapgar & Sane 1992)

Technology Developed by:

Faculty: Dr. Anvar Ali PH
Student team: Melbin Lal
Department of Fisheries Resource Management, Faculty of Fisheries Science

Introduction

The Indigo Barb (***Pethia setnai***) is a vibrantly colored ornamental fish species endemic to the Western Ghats of India, primarily distributed across west-flowing rivers in Maharashtra, Goa, and Karnataka. Valued for its striking appearance, this species faces significant threats from unregulated aquarium trade and habitat disturbances. As a result, it is listed as "Vulnerable" (VU) on the IUCN Red List. Developing captive breeding and culture techniques for ***P. setnai*** is crucial for its conservation and to meet the growing demand in the ornamental fish industry.

Methodology

I.Brood Collection

Broodstock of ***P. setnai*** can be maintained in well-planted aquariums and fed a nutritionally rich diet consisting of egg yolk, milk powder, prawn meat, clam meat, a vitamin-mineral mix, fish oil, and copepod-dominated mixed zooplankton cultured in green water. Domestication is recommended for one month prior to breeding trials to ensure the broodstock's health and reproductive readiness.

II. Sexual Dimorphism

Sexual dimorphism in ***P. setnai*** becomes prominent during the breeding season. Males display a striking reddish-pink coloration across their bodies, with vivid red margins on the dorsal and anal fins, which intensify during spawning, particularly in the dorsal, anal, and pelvic fins. Females, in contrast, are pale yellow with a faint red tinge along the unbranched rays of the dorsal fin. During spawning, the pelvic fins of females acquire a white-edged outer margin, a feature absent in males.

III. Breeding Trials

Breeding trials can be conducted in aquarium tanks measuring 0.75 m × 0.40 m × 0.50 m, furnished with aquatic plants. Brooders were anesthetized using clove oil at a concentration of 30 mg/L and induced with synthetic gonadotropin-releasing hormone (***WOVA-FH™***) at a dosage of 0.2 ml/kg body weight. After spawning, brooders have to be removed, and eggs gently aerated using an adjustable air pump to maintain optimal oxygen levels.

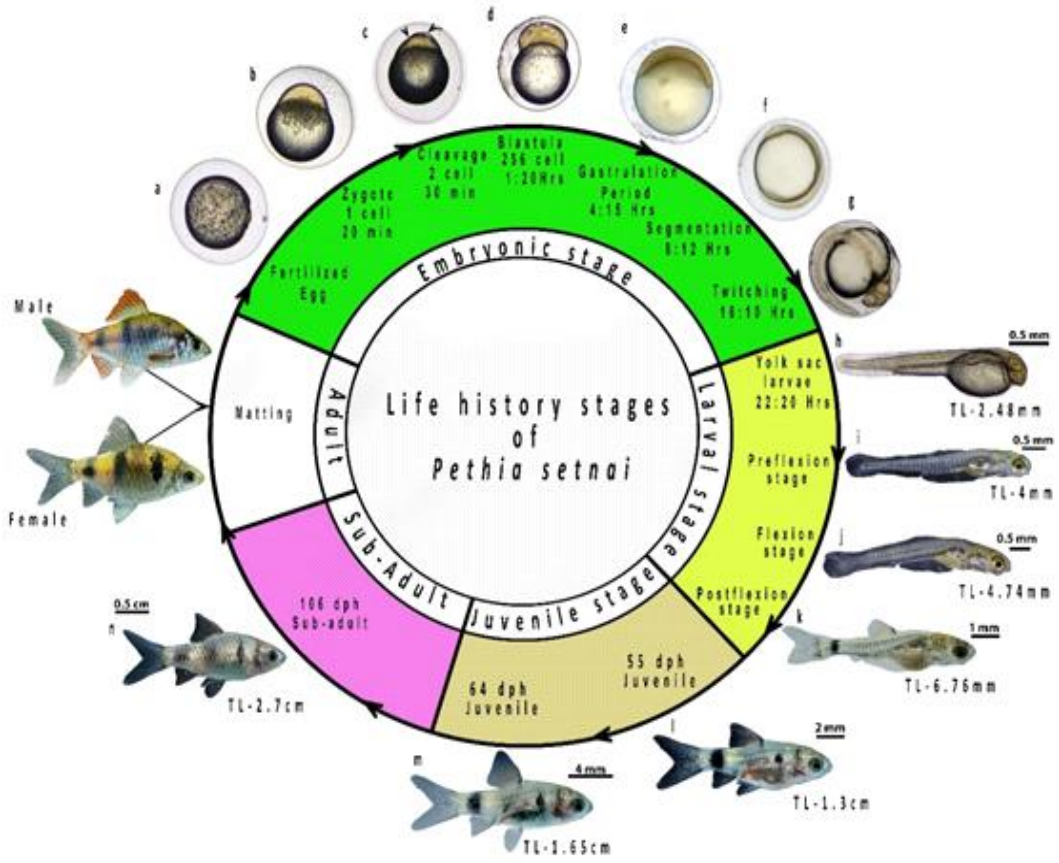
IV. Larval Rearing

Larvae begin hatching approximately 18 hours post-fertilization. By the fourth day, at an average temperature of 26.83 ± 0.76°C, and the yolk sac is fully absorbed. At this stage, larvae with a mouth size of 286.9 µm have to be fed with nauplii of freshwater copepods, sieved through a 100 µm mesh plankton net, to ensure optimal growth and survival.

V. Potential/ Anticipated Beneficiaries

Educated women entrepreneurs, activity groups under self-help groups, members of Kudumbasree Units, educated male youth etc.

Life cycle of the Indigo barb, *Pethia setnai*



Deliver the seeds to Dr. Parveen Kumar, Director, ICAR-CCARI, Goa

Banana stem based popcorn box

Technology Developed by:

Faculty: Dr. Jenny Ann John, Dr. Maya Raman
Student: Mr. Avinash Nair
Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies, Panangad, Kerala, India

Introduction

The increasing environmental concerns surrounding traditional packaging materials have led to a growing interest in sustainable alternatives. One promising option is utilising banana stem, a renewable resource with high lignin content, which offers desirable characteristics and yields. Its biodegradability and abundant availability make it an attractive choice for eco-friendly packaging solutions. Processing banana stems is relatively straightforward, and does not pose risks of recontamination, which is essential for food safety. Additionally, the barrier properties of packaging materials significantly influence their effectiveness, making it crucial to enhance these characteristics. In this context, coating the banana stem-based packaging with polylactic acid (PLA), a biodegradable polymer, improves both thermal and mechanical properties. This combination not only enhances durability but also maintains the sustainability of the packaging solution, making it suitable for a variety of applications. Overall, the integration of banana stem and PLA represents a promising avenue for developing effective, eco-friendly packaging technologies.

Materials used

Banana stem

Polylactic acid

Processing

Dried banana stems (solar drying)
Delignification, neutralization and beating

Addition of additives (glycerol and starch)

Casting and drying (50°C)

Coating with PLA and drying (50°C)

Product

Popcorn boxes made from banana stems coated with polylactic acid (PLA) have shown significant promise as a sustainable packaging solution. The use of banana stems not only leverages a renewable resource but also enhances biodegradability, making these boxes an environmentally friendly option. The coating with PLA improves both thermal and mechanical properties, ensuring that the boxes are durable enough to withstand the demands of packaging popcorn. This combination allows the boxes to maintain structural integrity while also being compostable at the end of their life cycle. Overall, this innovation represents a step forward in creating effective, eco-conscious packaging that meets consumer needs while minimising environmental impact.

Sugarcane based packaging materials

Technology Developed by:

Faculty: Dr. Maya Raman, Dr. Jenny Ann John
Student: Ms. Anagha Jayan
Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies, Panangad, Kerala, India

Introduction

Petroleum-based packaging systems contribute significantly to environmental degradation, prompting a need for more sustainable alternatives. One promising solution lies in the utilisation of sugarcane bagasse, a by-product of sugar extraction that generates 450 to 540 million metric tons annually (FAO, 2023). Currently, a small fraction of this bagasse is repurposed for construction, fuel, and animal feed, while the majority remains underutilized, posing a waste management challenge. By developing biodegradable packaging from sugarcane bagasse, we can effectively reduce our dependence on petroleum-based materials, mitigate waste, and promote a circular economy. This innovative approach not only addresses pressing environmental concerns but also enhances the economic value of agricultural by-products, paving the way for a more sustainable future.

Materials

Sugarcane bagasse

Processing

Dried sugarcane bagasse (solar drying)

Pulverization, delignification, neutralization and low power beating

Addition of additives (glycerol and pre-gelatinized starch)

Casting and drying (60°C/12h)

Framed into eco-friendly bags i

Product

Long fibers from sugarcane bagasse offer a promising sustainable alternative to traditional paper materials. These fibers exhibit superior mechanical properties, making them strong and durable, while also providing excellent moisture barrier capabilities. This combination not only enhances the performance of packaging but also ensures that products remain protected and have a comparable shelf-life to those packaged in conventional materials. By leveraging the unique qualities of sugarcane bagasse, we can develop eco-friendly packaging solutions that reduce environmental impact while meeting the demands of modern consumers. This shift not only supports sustainable practices but also contributes to the circular economy by turning agricultural waste into valuable resources.

Millet cookies in tea and coffee flavors

Technology Developed by:

Faculty: Dr. Maya Raman
Student team: Abhirami K. G. and Vyshak M. B.
Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies

Millets, small round cereal grains, with its abundant nutritional and health properties are gaining interest in recent years. The year 2023 is marked as the International Year of Millets, has paved way to considerable research and developments in millets.

Millet cookies are vegan in nature. These flavored with tea and coffee extracts, are having enhanced health potentials attributed to the high polyphenol contents from latter. The flavorings also improved the textural and sensory properties of these cookies

Ingredients

Foxtail millet flour or Barnyard millet flour
Coffee or tea extract
Butter
Vanilla essence
Water
Sugar

Nutritional fact (g/100g)

	Foxtail millet-Coffee Cookies	Barnyard millet - Tea Cookies
Energy	421.2 Kcal	408.2 Kcal
Protein	8.2	6.4
Fat	8.8	8.0
Carbohydrate	78.3	78.3
Fiber	10.1	8.0

Banana palm sugar gummy candy

Technology Developed by:

Faculty: Dr. Maya Raman
Student team: Nasva Naseem K.
Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies

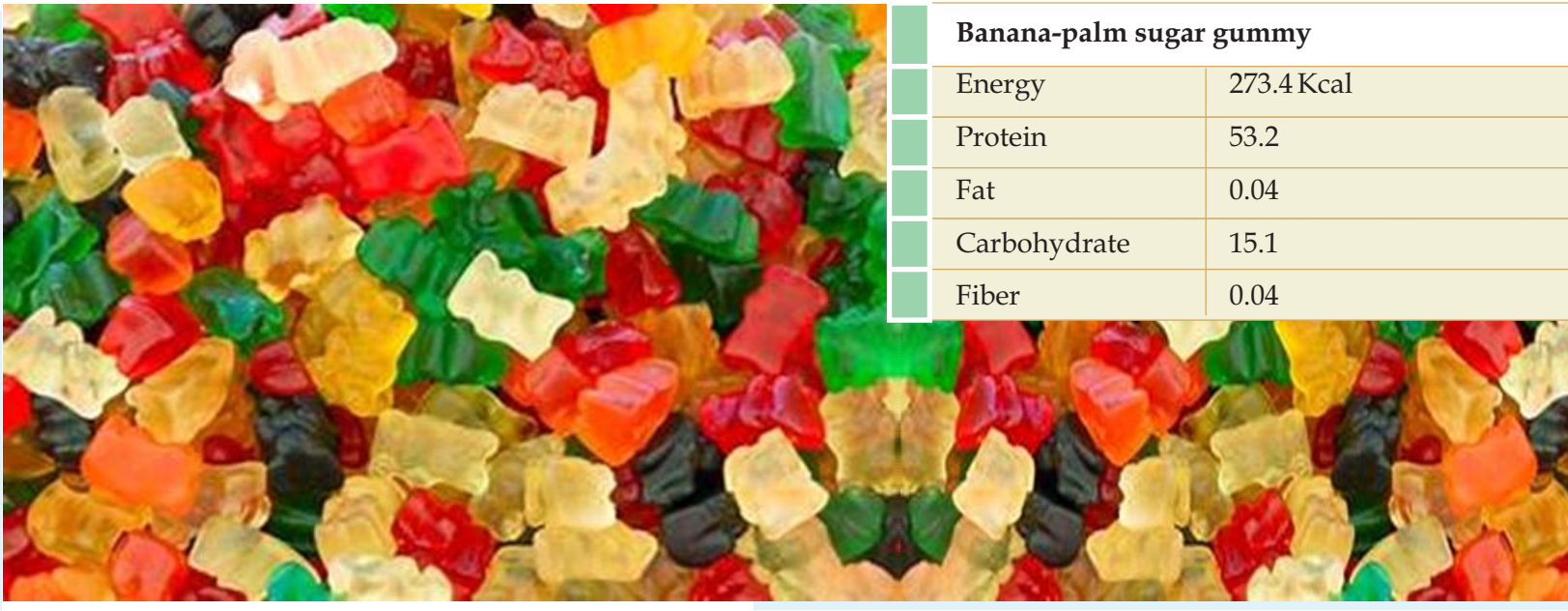
Gummy candies are relished particularly among children. These come in different shapes, sizes and flvaors. Gummy candies may be used for recreational and medicinal uses.
The banana-palm sugar gummy candy contains palm sugar and banana flour that regulates the sugar intake, has improve texture and flavor. This would be acceptable among all age groups.

Ingredients

- Palm sugar
- Banana flour
- Water
- Gelatin

Nutritional fact (g/100g)

Banana-palm sugar gummy	
Energy	273.4 Kcal
Protein	53.2
Fat	0.04
Carbohydrate	15.1
Fiber	0.04



Antioxidant Rich Finger Millet (Eleusine Coracana) Gummies

Technology developed by

Faculty : Dr Jenny Ann John
Student:Krishnapriya K.
Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies

Finger Millet Gummies

Gummies with
Finger Millet hull extract

Introduction

Finger millet or ragi (*Eleusine coracana*) is a nutritionally rich minor cereal which is greatly unutilized. These nutrient-dense millets are mainly used to develop breakfast products or as a staple food. Further, these can be efficiently utilized for the development of confectionery, using both millet flour and phenolic extracts of the millet hull. Millet enriched gummies are antioxidant and mineral rich products. For sweetness, palm sugar candies with lower glycemic index and higher minerals were used. Gummies are very popular among children, and millet enriched gummies have a huge potential to be popular as a functional confectionary.

Ingredients

Finger millet
Pectin
Palm sugar candy

Process flow

Washing, soaking and drying of finger millets
Dried millets roasted and ground to fine flour
Millet flour, pectin and palm sugar candy dissolved in water, cooked, moulded, packed and stored
For hull extract enriched gummies: Millet hulls are ground and extracted using solvent. Solvent is evaporated and the concentrated extract used for gummy preparation

Nutritional Profile (g/100g)

Protein	2.5
Fat	1.5
Carbohydrate	42.6
Fibre	0.9

Ready-To-Cook Raw Jackfruit-Based Meat Analogue

Technology developed by

Faculty : Dr Jenny Ann John
Student:Chinju S.
Department of Food Science and Technology, Faculty of Ocean Science and Technology, Kerala University of Fisheries and Ocean Studies

Introduction

Plant based meat analogue is an alternative protein source to substitute the traditional animal-based food. They have similar nutritional, sensory and functional property like traditional meat. The developed ready-to-cook nuggets/balls uses jackfruit and paneer as major ingredient; with paneer replaced by tofu in vegan products. Texturized soy protein and red kidney beans is used as a protein source and potato starch as a binder. The developed product is kept frozen till it is ready to be fried. The raw jackfruit extends a fibrous texture, while the paneer/tofu adds to the protein content and increased acceptability.

Ingredients

Raw jackfruit Paneer/Tofu	· Red kidney beans
Wheat gluten Soy chunks	· Potato starch
Coconut oil Garlic powder and flavour mix	· Salt

Process flow

Textured soy protein was hydrated by soaking in water and ground. Raw jackfruit was ground, blended and sautéd with other ingredients as spices, flavour, paneer/tofu, cooked red kidney beans, wheat gluten, and salt. The mixture was moulded, par fried, packed and stored frozen until further processing for final consumption.

Nutritional Profile (g/100g)

Jackfruit based nuggets with paneer tofu

Protein	20.40
Fat	23.07
Carbohydrate	26.22
Fibre	9.05

Jackfruit based nuggets with

Protein	18.88
Fat	15.55
Carbohydrate	12.14
Fibre	9.1

Ready-To-Fry Indigenous Tuber Fries

Technology developed by

Faculty : Dr Jenny Ann John
Student:Velu Anand K.
Department of Food Science and Technology, Faculty of Ocean Science and Technology , Kerala University of Fisheries and Ocean Studies

Air- and Oil-fried Tapioca Fries

Air- and Oil-fried Taro fries

Air- and Oil-fried Sweet potato fries

Introduction

French fries from potato are the most preferred snack by people of all age groups. However, hot air frying is a healthier option to frying in hot oil. Moreover, fries from indigenous tubers such as Taro, Tapioca and Sweet potato are more nutritious than potatoes. Ready-to-fry tuber fries were successfully developed by par-frying and may be stored under frozen conditions till further processed for consumption. These alternative tuber fries are healthier in terms of oil content and nutritive value.

Ingredients

Tuber: Tapioca / Taro / Sweet potato
Salt
Ascorbic/Citric acid
Oil

Process flow

Cutting the tubers into desired size and dipping to prevent browning
Blanching followed by drying and moisture equilibration
Par-frying or air-frying; packing and freezing
Final product may be deep fried or air fried

Nutritional Profile (g/100g)

Fried Tuber		Carbohydrate%	Protein%	Fats%
Tapioca	Oil fried	62.45	1.55	6.63
	Air fried	66.83	1.39	1.67
Taro	Oil fried	41.14	2.45	19.18
	Air fried	52.45	2.45	3.16
Sweet potato	Oil fried	43.23	1.01	12.34
	Air fried	47.47	1.48	1.50

Shelf-Stable, Tray Dried, Ready-To-Cook Banana Blossom (*Musa Paradisiaca*)

Technology developed by

Faculty : Dr Jenny Ann John
Student:Archana Ravindran.
Department of Food Science and Technology, Faculty of Ocean Science and Technology , Kerala University of Fisheries and Ocean Studies

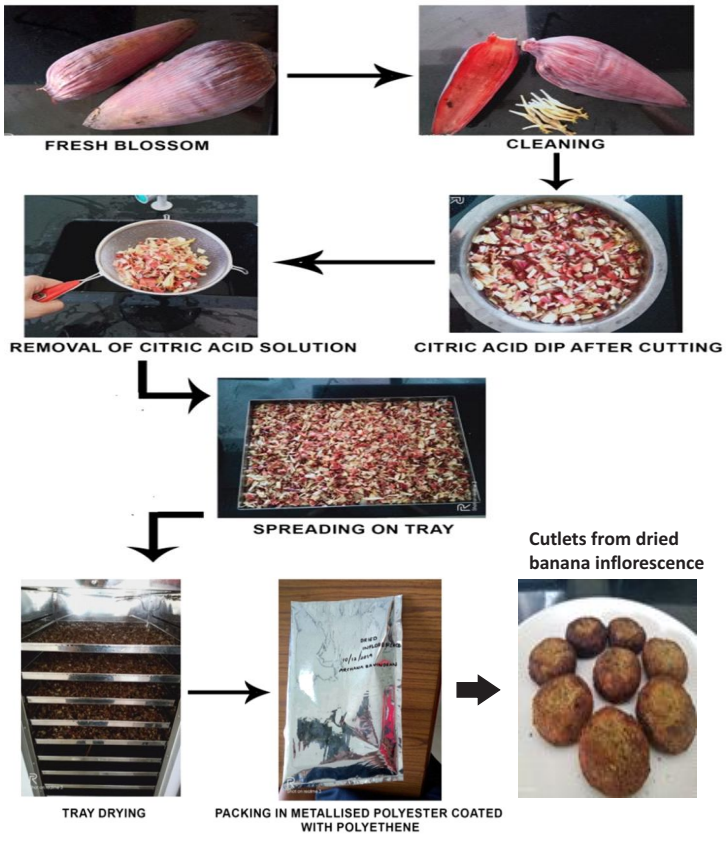
Introduction

Banana blossom or inflorescence is an underutilised agricultural by-product, though rich in fibre and therapeutic properties. Moreover, it is a highly perishable, undergoing fast browning. Developing a packaged, shelf-stable, ready-to cook product from the blossom would offer consumers a convenient, highly nutritious option, in addition to reducing agricultural wastage and improve the economic status of farmers. Well packaged blossoms could be stored at room temperature for at least a period of two months without affecting nutritional and sensory qualities. Such shelf stable, ready-to-cook banana blossom will be a versatile, value-added product. Cutlet made out of dehydrated and stored blossom were well accepted.

Ingredients

Banana blossom
Citric acid

Process flow



Nutritional Profile

Proximate composition	Raw blossom (%)	Tray dried blossom (%)
Moisture	92.80	12.49
Fat	0.23	3.70
Protein	0.99	13.75
Ash	0.88	12.14
Carbohydrate	5.10	57.92
Crude fiber	2.43	18.05

Seaweed Lavers with Seafood Seasonings

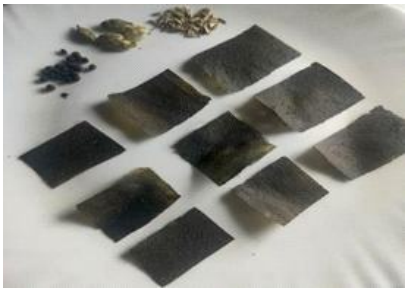
Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student: Swetha Kattookkaran
Department of Fish Processing Technology Faculty of Fisheries Science & Centre for Advanced Studies and Research in Entrepreneurship Development in Fisheries, Agribusiness and Allied Sectors, Kerala University of Fisheries and Ocean Studies

The product

Seaweed laver, is a type of edible seaweed sheet that is widely consumed in East Asian cuisine, particularly in Japan, Korea, and China. It's a versatile ingredient with a unique flavor and texture that adds depth and complexity to various dishes. Laversheets are most commonly used to wrap sushi rice and filling, creating the iconoic sushi rolls. Dried laver sheet can be eaten on their own as a healthy and flavourful snack. These can be used to wrap other foods such as rice , vegetables or meat. Laver can be added to soup and stews for flavour enhancement and nutrients as well as seasoning to garnish various dishes.
Lavers can be modified into different forms (raw, dried, roasted and seasoned) incorporated into various foods and also consumed as ready-to-eat snacks. Since snacking is common behaviour, especially for children, the development of healthy Laver snacks from native seaweed species enriched with seafood seasoning powder (Anchovy powder) and spices can enhance flavour and acceptability.

Fish Flavoured Laver



Laver with Indian spices

Nutritional fact (g/100g)

·Energy	222.6 Kcal
·Protein	12.69 g
·Fat	15.1 g
·Carbohydrate	8.90 g

Ingredients

Seaweed (*Ulva lactuca*)
Spices
Salt
Olive oil
Water
Anchovy powder

Process flow

Seaweed is washed well with fresh water until it is free from dirt and then filtered through a strainer and allowed to drain. Washed clean seaweed is blended well in a mixer with water, olive oil, salt and spices for about 1 minute. The seaweed mixture is then cooked for 10 minutes at 40 ° C to a thicker consistency. Pour the mixture into the Mold and dry in a hot air oven at 100 °C for 2 hrs 30 minutes to obtain a crispy laver sheet. Laver can be developed with different flavours by incorporating fish powder and shrimp powder along with the ingredients. For fish flavoured laver anchovy powder is added along with the ingredients.

Technology Transfer cost -Rs.40,000/-

Protein Isolate Enriched Catfish Sausages

Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student : Jeffia M. Antony
Department of Fish Processing Technology Faculty of Fisheries Science & Centre for Advanced Studies and Research in Entrepreneurship Development in Fisheries, Agribusiness and Allied Sectors, Kerala University of Fisheries and Ocean Studies

The product

Freshwater fish have gained attention as a versatile ingredient in the production of sausage. Catfish (*Arius arius*) are nutritious fish but have low commercial value. The processing of catfish into an innovative product with longer shelf life can add value to the fish. This innovative approach not only diversifies meat products but also enhances nutritional value and addresses sustainability concerns. Catfish sausages represent an exciting innovation in the meat processing industry, combining the unique qualities of catfish with traditional sausage-making techniques. This approach not only diversifies the sausage market but also highlights the potential of underutilized fish species. Catfish is a lean protein source, providing a healthier alternative to the higher-fat meats often used in sausages. Its low fat content allows for a nutritious option without sacrificing flavor or satisfaction. While not as rich in omega-3s as some saltwater fish, catfish still offers beneficial fatty acids that contribute to heart health. Packed with B vitamins (like B12) and minerals (such as phosphorus and selenium), catfish sausages can significantly enhance meal nutrition. Catfish has a mild, slightly sweet flavor that lends itself well to various spices and herbs. The protein content is increased in this product by adding protein isolate extracted from fish processing side streams.

Nutritional fact (g/100g)

Energy	-	158.76 kcal
Protein	-	21.45 g
Lipid	-	9 g

Ingredients	Quantity
Mince	65 gm
Egg white	2 gm
salt	2.5 gm
sugar	1.5 gm
Coriander powder	0.5 gm
Chilli powder	0.5 gm
Garlic paste	1 gm
Vegetable oil	4.5 gm
White pepperpowder	1.5 gm
Ginger powder	1 gm
Corn starch	10 gm
Crushed ice	8 gm
Fish Proteinisolate	2

Process Flow

Prepare mince from the fish by deboning. Weigh all the ingredients for preparation of sausage. Mince was mixed well with the ingredients for 10 minutes. Crushed ice was added in between the mixing of ingredients to maintain the temperature close to 15–16 °C. Prepared paste was stuffed into cellulose casing using sausage stuffer. After stuffing the paste tying it using thread at required length by manually. The stuffed casings were boiled at 90°C for 45 min. Then cooling it for 15 min using chilled water. The sausages were heated again at 100°C for 30s to remove surface wrinkles. Then sausages were stored at refrigerated condition.

Technology Transfer cost -Rs.40,000/-

Seaweed Noodles

Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student : Roopa Rajan
Department of Fish Processing Technology Faculty of Fisheries Science & Centre for Advanced Studies and Research in Entrepreneurship Development in Fisheries, Agribusiness and Allied Sectors, Kerala University of Fisheries and Ocean Studies

The product

Seaweed noodles offer a unique and nutritious alternative to traditional noodles. Packed with essential vitamins, minerals, and antioxidants, these noodles provide a delicious and healthy way of sustainable choice. Seaweed is rich in essential nutrients like iodine, calcium, vitamins, and fiber, which are often lacking in standard wheat-based noodles. The inclusion of seaweed adds valuable minerals and bioactive compounds like antioxidants, making the noodles a more nutritious option for health-conscious consumers. This combination also caters to evolving dietary trends, where people are increasingly seeking functional foods that not only satisfy hunger but also provide health-boosting properties. As a result, seaweed-added noodles can appeal to a broad range of consumers looking for healthier, more sustainable food choices without compromising taste or convenience.

Ingredients

Wheat flour,
Seaweed (*Ulva lactuca*),
Salt,
Water

Process flow

Mix wheat flour, seaweed and salt together in a pasta extruder machine.
Adjust the water level such that it favours fine extrusion of the product.
Fix the dye and start extrusion. Adjust the length of noodle with the blade attached in the extruder.
Dry the fresh noodles at 50°C until the moisture level reaches below 10%.
Pack in sealed containers or pouches and store in cool and dry place.

Nutritional fact (g/100g)

Energy: 276 kcal
Fat: 0.8455 g
Protein: 14.51 g
Carbohydrate: 52.80g
Crude fiber: 3.55g

Backyard Hatchery Technology for Karimeen (Etroplus suratensis)

Technology developed by

Faculty: Dr. Binu Varghese*
Students: Thiruvarasu S, Grace George
Department of Aquaculture, Faculty of Fisheries Science & Centre of Excellence in Sustainable Aquaculture and Aquatic Animal Health Management, KUFOS

Introduction

Karimeen fishery is in the verge of collapse due to environmental degradation, climate change and destructive fishing practices. Production enhancement can be achieved by conserving resources and reviving aquaculture practices. A viable mass seed production and nursery-rearing technology were developed by KUFOS in 2020. Through proper technological intervention, the status of Karimeen aquaculture can be revived. This will generate viable employment opportunities at various strata like seed production, nursery rearing for the production of fingerlings, cage/pond culture, value addition, and marketing.

Backyard Hatchery for Karimeen

A simplified and easily adaptable backyard hatchery model was developed by KUFOS apart from mass production technology. The backyard system supports production of about 50,000 seeds per annum. The facilities required for backyard hatchery of Karimeen are FRP tanks (brooder, larval and fry rearing), aeration and plumbing system, planter pots (egg attachment), filtration units, shade net/ shelter apart from inputs like fish, feed, water test kits, etc. In this system, fish were provided with one square meter area. The hatchery can produce seeds throughout the year with proper water and feed management and brood care. The eggs or hatchlings were shifted to facilitate repeated spawning.

Backyard Hatchery Technology for the 'Olive Barb' (Kuruva)

Technology developed by

Faculty: Dr. Anvar Ali PH
Student team: Melbinlal, Lovedeep Sharma
Department of Fisheries Resource Management, Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies

Introduction

Olive Barb (*Systomus sarana*) is a medium sized native freshwater barb having both food and ornamental value. Once abundant in the flood plain wetlands and low land rivers in Kerala, anthropogenic stress has drastically reduced populations in the wild.

A promising candidate species for: Polyculture with Indian Major Carps and freshwater prawn, stock enhancement in reservoirs and floodplain wetlands (Vembanad-Kole Kaippad and Kuttanad wetlands) and biological eradication of aquatic weeds

Life history information: It breeds at the onset of south west and north east monsoon in Kerala. Lays around 3000 to 6000 eggs on submerged plants. The hatchlings also attach to plant substrata. Initial larval stages feed on zooplankton. Early juveniles and sub adults feed on larval forms of insects.

Technology intervention: Broodstock development with supplementary diets. Induced breeding by hormone administration. Provision of spawning substrata. Larval rearing using mixed zooplankton culture (dominated with freshwater copepods). Larval rearing in hapas/ 'green water system'.

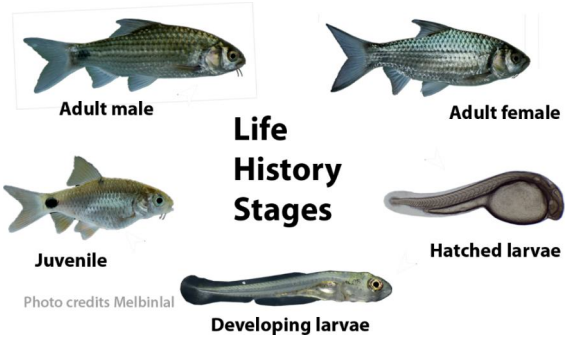
Basic Requirements

Small concrete cisterns/FRP tanks/large aquariums/Silpaulin ponds, hormones and accessories, aerators and accessories, spawning substrates, filtration system, nets and accessories, hapas etc. Hands – on training on aspects of farming and seed production essential.

Potential/ Anticipated Beneficiaries: Educated women entrepreneurs, activity groups under self-help groups, members of Kudumbasree Units, educated male youth *etc*.

Beneficiaries, so far: Tribal fisher families in Idamalayar Reservoir catchment, 250 fish farmers in five LSGDs in Munnar Landscape.

Funding and permission for research: The project was supported by the UNDP-India High Range Mountain Landscape Project, in collaboration with the Ministry of Environment, Forest and Climate Change, Government of India, and the Global Environment Facility (GEF). Authorization for brood fish collection was granted by the Chief Conservator of Forests, Kerala Forests and Wildlife Department, Government of Kerala, through Forest Permit No. KFDHQ-5276/2020-CWW/WL10, dated 01 March 2021.



Cashew Nut Waste Based Feed for Tilapia

Technology developed by

Faculty: Dr Chiranjiv Pradhan, Dr T. V. Sankar
Student team: Bala Gopinath Divi, Namitha Dileep, Nikhila Peter
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Introduction

The global demand for aquafeed continues to increase in order to support the ever-growing aquaculture industry. There is also an increasing pressure on the traditional protein resources for feed preparation. Soya bean meal (SBM), after fishmeal, is the most expensive ingredient in the fish feed. At the same time, SBM contains certain anti-nutritional factors such as trypsin inhibitor and phytate, which limit the utilization of protein and essential minerals respectively. The higher inclusion level (>40%) of SBM is associated with intestinal problems in many fish species. Therefore, there is a potential need for the replacement of soya bean with other suitable ingredients. Cashew nut meal (CNM) consist of cashew nut processing waste. It contains 35%–40% crude protein and is rich in amino acids such as phenylalanine, leucine, arginine, isoleucine, methionine and lysine. CNM is a potential ingredient for aquafeed formulation

Feed Preparation

All the plant ingredients were ground to a fine powder and mixed with vegetable oil and vitamin–mineral mix as per the feed formulation (Table 1). The mixture was then compressed into pellets in a semi-industrial pellet machine (meat mincer) using a 1-mm die (Fig. 1). The pellets were dried in a drier at 55°C overnight and fed to the fish.

Table 1: Feed for tilapia

Ingredient	Composition (g/kg)
Soyabean meal	200
Cashew nut meal	400
Ground nut oil cake	230
Maize	50
Rice bran	50
Oil	20
Vit min mix	10
Salt	10
Yeast	10
cellulose	10
CMC	10

Product

The product was developed replacing 50% of soybean meal with CNM in the diet of tilapia. This is an all-plant ingredient based feed. CNM is locally available at a much cheaper price than SBM. CNM appears to be a suitable ingredient at 40% incorporation level along with 20% soya bean meal in the diet of tilapia. In addition, CNM also exhibited the lowest economic conversion ratio in this replacement level.

Fig 1. Different steps of feed preparation

Powder of ingredients

Mixing

Pelletizing

Drying

Farm made feed for Indian Major Carps (IMCs)

Technology developed by

Faculty: Dr Chiranjiv Pradhan
Student team: Nikhila Peter and Namitha Dileep
Department of Aquaculture, Faculty of Fisheries Science & Centre of Excellence in Sustainable Aquaculture and Aquatic Animal Health Management, Kerala University of Fisheries and Ocean Studies

Introduction

Indian major carps (Catla, Rohu and Mrigal) are the mainstay of Indian aquaculture. In carp culture, the use of commercial feeds is restricted to about 3% only and rest 97% comes as farm-feed prepared by the farmers in India. The use of cakes of edible oil seeds as ingredients is becoming too competitive and costly especially for farm made feed formulations. Depending on needs and affordability, the cake-bran mixture however is further improved with supplementation of nutrient rich newer variety of plant and animal ingredients for enhancing the feed quality. The use of farm made feed and preparation of farm made feed from non-conventional ingredients for small scale aquaculture practice will be a great help for farmers of Kerala.

Product

The feed was prepared taking copra meal, groundnut oil cake (GOC), rice bran (RB), tapioca and vitamin and mineral mix (Table 1). The crude protein and lipid level was 29% and 6% respectively.

The feed is suitable for all growth stages of IMC in pond culture condition. Semi industrial pelletizer can be used for the preparation of 3 mm size pellet of this feed for grow out fish. The crumbled pellets of 2mm, 0.5 mm and 50-80µm is suitable for IMC fingerling, fry and spawns, respectively.

Feed Preparation

Table 1: Farm made feed for IMC

Ingredients	Composition(g/Kg)
Copra meal	200
Ground nut oil cake	500
Rice bran	270
Vitamin-Mineral mix	10
Tapioca flour	20
Chemical composition	
Crude protein	292
Ether Extract	60.6
Crude fibre	85
Ash	75.2
Nitrogen free extract	497.2

Insect based feed for Pangasianodon hypophthalmus (Pangasius)

Technology developed by

Faculty: Dr Chiranjiv Pradhan
Student Team: Ardra M
Department of Aquaculture, Faculty of Fisheries Science & Centre of Excellence in Sustainable Aquaculture and Aquatic Animal Health Management, Kerala University of Fisheries and Ocean Studies

Introduction

Insect larvae are considered as the most promising and sustainable alternative protein ingredient in aquafeeds due to their high protein content, amino acid profile, fast multiplication and carbon footprint. Black solider fly (BSF: *Hermetia illucens*) is one of the most promising insects and has the ability to bio-convert wide range of organic matter into sustainable protein. The nutrient profile of BSF larvae (BSFL) is determined by the substrate they consume. A BSFL weighs approximately 0.1 to 0.2 grams and contains 42% protein and 35% fat by dry weight. In aquaculture BSFL have been extensively studied, and in many fish species this can partially or completely replace fishmeal from feed.

Feed Preparation

BSF ensilage prepared
Grinding of the ingredients
Mixing
Pressure cooking
Pelletizing
Drying

Table 1: Feed for pangasius

Ingredients

Composition(g/Kg)	
Ensiled BSF	300
Soy protein isolate	100
Soybean meal	300
Corn flour	120
Wheat flour	150
Vitamin-mineral mix	20
Salt	2
Yeast powder	2
Carboxy methyl cellulose	5
Antioxidant	1

Product

Pangasius feed was prepared by 100% replacement of fishmeal with ensiled BSFL (Table 1). The feed was palatable for Pangasius and contributed to growth of the fish. The body crude protein and lipid were also unaffected by the inclusion of BSFL. The total replacement of fishmeal with BSFL was possible in Pangasius diet. BSFL based feed reduced the overall operational cost of Pangasius farming as well.

Seed Production of Malabar Dwarf Puffer (*Carinotetraodon travancoricus*) Endemic fish of the Western Ghats

Technology developed by

Faculty: Dr. Binu Varghese
Student team: Chandana B L, Ashly Sanal
Department of Aquaculture, Faculty of Fisheries Science, Kerala University of Fisheries and Ocean Studies

Introduction

The smallest known puffer species, Malabar dwarf puffer *Carinotetraodon travancoricus*, is endemic to rivers originating from the Western Ghats. It is called Dwarf /Pygmy/Pea Puffer due to its smaller size, which barely reaches more than 30 cm. It is one of the most exported ornamental fish from India and is widely collected from the rivers of Kerala. Increasing demand in global trade has resulted in large-scale exploitation of this fish from its natural habitats. Apart from their size, the most characteristic feature is pronounced sexual dimorphism. Males are usually more brightly coloured and possess erectile ridges along the belly. As per IUCN reports, their population in the wild has declined 30-40% in recent years and is showing a decreasing population trend and has been enlisted under the Vulnerable (VU) category.

Captive Breeding of Dwarf Puffer

The propagation of Malabar Dwarf Puffer was done successfully under captivity. The occurrence of mature individuals in the wild population was reported during June-July and in September-October. The fishes were observed to spawn continuously, sometimes daily, in the artificial breeding environment. The eggs were deposited on the tank bottom in the substrate provided, and the eggs were spherical with an average diameter of 1.4 mm. They were transparent and non-sticky with a pale yellow colouration. The incubation period varied between 96 to 116 hours

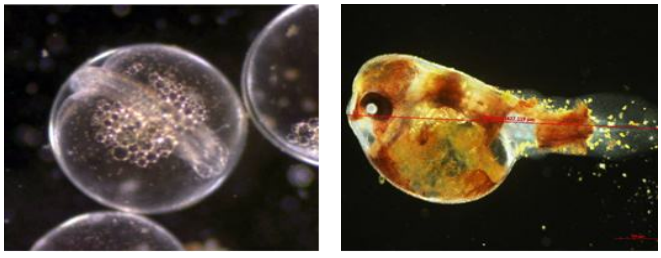


Fig 2. Developing embryo of Dwarf Puffer

The newly hatched larvae had an average length of 3.5 mm and were brightly pigmented with an enormous yolk sac. The larvae were fed with newly hatched Artemia nauplii, Moina neonates, etc initially. As they grow, they were fed with blood worms, frozen Artemia, mosquito larvae, etc.

Acknowledgments

This technology was developed under the KUFOS Aided Research Project (KARP) (DoR/4751/2019 dated 22.6.2019)

Ultra Violet Assisted Vertical Re-Circulatory Depuration System

Technology developed by

Faculty: Dr. Abhilash Sasidharan, Dr. Binu Varghese
Student team: Anjana Sunil
Department of Fish Processing Technology, Faculty of Fisheries Science &
Earn While You Learn Programme, Kerala University of Fisheries and Ocean Studies

Introduction

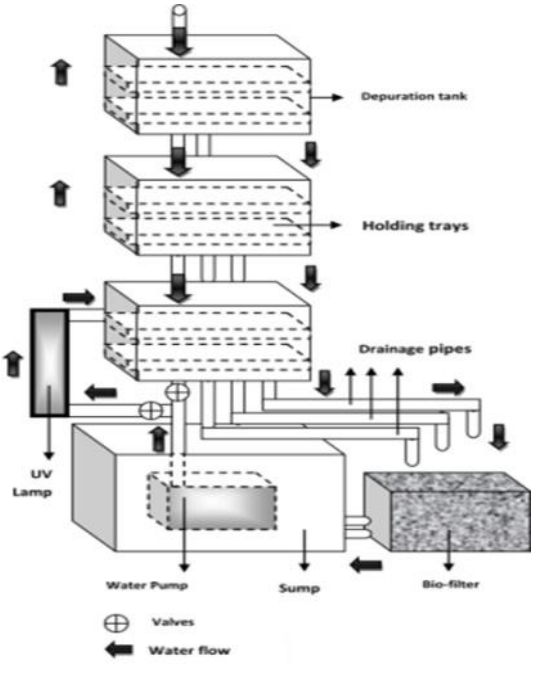
The most effective and reliable approach to producing safer shellfish to the consumer is to grow or harvest them from unpolluted or less polluted water bodies which is practically impossible in current scenario. Harvesting must be then followed by depuration, which is a process of flushing away the waterborne contaminants like pathogens including bacteria and viruses, bio-toxins, and heavy metal from their body by keeping them live in clean water systems and avoiding recontamination or relaying the live shellfishes in the lesser polluted natural water bodies for longer periods.

The Product

KUFOS presents a cost-effective, portable, ultraviolet assisted vertical re-circulatory depuration system which is effective in the reduction of total viable count by 1.8 log cfu g-1, keeping *Escherichia coli* within the permissible limit and making sure both *Vibrio cholera* and *V. parahaemolyticus* are absent.

The concentrations of heavy metals (Cd, Pb and Cu) were found to decrease by 40.44%, 96.51% and 34.50% respectively at the end of 48 h of depuration in UVDC. Significant reduction in protein, lipid, ash and glycogen contents were observed after the depuration process. The portability and easy to assemble nature of the system further improves its applicability as an onsite depuration unit which could be effectively utilized by the small-scale clam fishers/farmers depending on polluted waters for enhancing their income and livelihood.

Processing



Calcium Incorporated Gluten Free Cookies

Technology developed by

Faculty: Dr. Blossom K L
Student team: Ligi Jose
Department of Fish Processing Technology,
Faculty of Fisheries Science Kerala University of Fisheries and Ocean Studies

Introduction

Calcium incorporated gluten free cookies is effective for calcium deficiency and persons who are allergic to gluten protein.

The product is rich in fibre, calcium, phosphorous, magnesium, sodium and potassium and it helps to meet the recommended daily allowance (RDA) for calcium.

Processing Method

Extract calcium from tuna bone powder Mix all ingredients together

Resulting dough is sheeted and cut into equal size Bake at 180˚C for15 min

Cool at room temperature for 1 hr.

Ingredients

- Rice flour
- Quinoa flour
- Calcium powder
- Chocolate spread
- Brown sugar
- Cinnamon
- Egg
- Baking powder

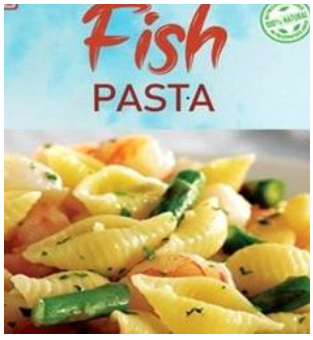
Nutritional Profile/100g

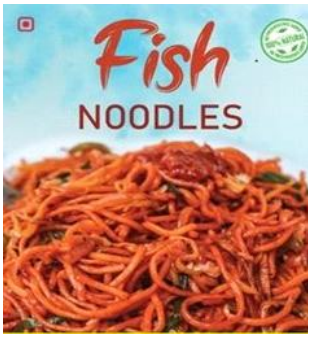
Protein	: 8.9 g
Carbohydrate	: 73g
Total fat	: 8.7 g
Calcium	: 699 mg
Sodium	: 29.8 mg

Fish Based Pasta and Noodles

Technology developed by

Faculty: Dr Blossom K L*, Dr T. K. Srinivasa Gopal Student team: Jisto Mathew
*Department of Fish Processing Technology,
Faculty of Fisheries Science &
Centre of Excellence in Food Processing and Packaging Technology, Kerala University of Fisheries and Ocean Studies





Introduction

Nowadays due to busy life style, consumers are attracted to RTE and RTC foods.
Pasta products are termed as 'junk food' which do not give much health benefit. In order to make foods more healthy, fortification of foods is done by adding biological active compounds. Fish is an excellent source of high nutritional value protein and an excellent source of lipid.

Ingredients

- Wheat flour
- Fish mince (Tilapia)
- Salt
- Water

Processing Method

Nutritious fish pasta and noodles are prepared by incorporating 30% tilapia mince with wheat flour and are mixed and extruded in single screw extruder. The product is then dried to 30% moisture content. The product is packed in polythene bags, labelled and stored.

Nutritional Profile

Protein	-	17.15%
Fat	-	0.744%
Shelf life	-	90 days

Jelly

Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student team: Neha P Nair, Zuhara Muhammed Hussain, Fathima Asharaf, Jamshi J, Nandhu G, Roopa Rajan
Department of Fish Processing Technology Faculty of Fisheries Science
& Centre for Advanced Studies and Research in Entrepreneurship Development in Fisheries, Agribusiness and Allied Sectors, Kerala University of Fisheries and Ocean Studies

The product

Jelly is a class of sugar confectionery based on a hydrocolloid that is prepared by boiling a clear solution of fruit juice or fruit flavour that beneficial for human health. It is sticky textured and transparent shaded with a sweet chewy consistency.

The uniqueness of the product is the incorporation of fish gelatin, a versatile hydrocolloid as the gelling agent. Despite of utilizing fishery discards for gelatin production, it provides an effective way to overcome problems, such as health and religious issues that might arise from the consumption of gelatin obtained from the mammalian sources.

Nutritional fact (g/100g)

	Energy	:	255.2 Kcal
	Protein	:	3.6g
	Carbohydrate	:	60.2g
	Fat	:	0 g

Ingredients

- Fish Gelatin
- Water
- Sugar
- light corn syrup
- Vanilla essence
- Food colour (permitted synthetic food colour)

Process flow

Take a pan, add 1 cup of water, add approx. ½ cup of sugar to it and boil it for 3-4 minutes

Take 2-2.5% fish gelatin and add it to lukewarm water, keep it aside till it become spongy

Once the sugar reaches a boiling stage of thread like consistency, add the fish gelatin into the sugar syrup, add 1-2 drops of fruit flavour and 2 drops of food colour to the mixture, mix well

Pour the mixture into mould to get desires shape and keep it for 2-4hrs and after that demold it

Technology transfer cost- Rs.15,000/-

Marshmallow

Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student team: Fathima Asharaf, Neha P Nair, Zuhara Muhammed Hussain, Jamshi J, Nandhu G, Roopa Rajan
Department of Fish Processing Technology Faculty of Fisheries Science & Centre for Advanced Studies and Research in Entrepreneurship Development in Fisheries, Agribusiness and Allied Sectors, Kerala University of Fisheries and Ocean Studies

The product

Seafood processing is an important economic activity worldwide. However, it results in bulk solid waste generation whose disposal and management are a serious concern. Secondary processing and valorization for recovery of value-added products such as gelatin seems as better alternative to this.

Fish gelatin, a multifunctional ingredient possesses an excellent whipping property, used for the formation of foam in marshmallow. Marshmallow, an aerated confectionery product is very popular among kids because of unique textural properties and mouth- feel. The incorporation of gelatin provides a spongy structure and enhances the protein content of marshmallow and increased acceptability.

Nutritional fact (g/100g)

Energy- 254.4 Kcal
Protein- 3.4g
Fat-0g
Carbohydrate- 60.2g

Ingredients

Fish Gelatin
Sugar
Light corn syrup
Vanilla essence
Corn starch/Corn flour- mix with icing sugar
Water

Process flow

A solution is formed by dissolving sugar and corn syrup in water and boiling it and fish gelatin is mixed with the sugar solution. Then the ingredients are heated and passed through a strainer to remove extraneous matter. The mixture is then beaten into foam to two or three times its original volume. At this stage, flavouring can be added. The mixture is then placed in a mould, cooled, cut and dried. A coating of corn starch is added to counter stickiness and help maintain their form.

Technology transfer cost- Rs.15,000/-

Seaweed Pasta

Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student team: Roopa Rajan
Department of Fish Processing Technology Faculty of Fisheries Science
& Centre of Excellence in Food Processing Technology, Kerala University of Fisheries and Ocean Studies

Nutritional fact (g/100g)

Energy	:	234 kcal
Fat	:	0.013g
Protein	:	3.442g
Carbohydrate	:	55.31g
Crude fibre	:	3.08g

The product

Malnutrition is the leading cause of immunodeficiency in the world, affecting primarily children, adolescents, and the elderly, making them more susceptible to infections. Application of seaweed based nutritional food is a viable current alternative to overcome this since seaweed cuisines are considered as highly valuable foodstuff around the globe, because of their nutritional importance.
Pasta is considered a healthy food being relatively low in fat, high in carbohydrate, and with good protein content. Nutritional improvement of pasta mainly involves increasing protein and dietary fiber content and the fortification with vitamins and minerals.
The addition of abundantly available seaweed as an ingredient in wheat pasta will enhance the nutritional profile of traditional pasta formulations with significant health benefits for all age groups.

Ingredients

Wheat flour

Seaweed (Ulva reticulata)

Salt

Water

Process flow

Mix wheat flour, seaweed extract and salt together in a pasta extruder machine

Adjust the water level such that it favors fine extrusion of the product.

Fix the dye of desirable shapes and start extrusion.

ack in sealed containers or pouches and store in cool and dry place.

Technology transfer cost- Rs.40,000/-

Sugar Coated Gummy

Technology developed by

Faculty: Dr. Radhika Rajasree S.R
Student team: Zuhara Muhammed Hussain, Fathima Asharaf, Neha P Nair, Nandhu G, Jamshi J, Roopa Rajan
Department of Fish Processing Technology Faculty of Fisheries Science & Centre for Advanced Studies and Research in Entrepreneurship Development in Fisheries, Agribusiness and Allied Sectors, Kerala University of Fisheries and Ocean Studies

The product

Fish gelatin is a derivative product from the hydrolysis of collagen contained in the bones and skin of animals. It has a thermo-reversable gel formation ability and "melt in mouth texture", thus it acts as an active agent in the formulation of jelly-based confectioneries.

Sugar coated gummy is a fish gelatin based chewable sweet with food acids such as citric acid or mallic acid in order to give a tart flavour. They are characterized by a nice and delicate texture. It is coated with sugar, thus increases then shelf life, elastic and chewiness which bring wonderful mouthfeel.

Nutritional fact (g/100g)

Energy	:	330.8Kcal
Carbohydrate	:	80g
Protein	:	2.7g
Fat	:	0g

Ingredients

Sugar

Fish gelatin

Fruit flavour

Permitted food colour

Citric acid

Water

Process flow

A solution is formed by dissolving sugar and corn syrup in water and boiling to Firm ball stage (242 - 248˚F).

Gelatine is added at this stage and cooked for 1 – 2mins and flavorings and colours are added.

The jelly mixture is poured into a starch mold or a plastic mold, and solidified.

The jellies are then coated with layer of powdered sugar.

Technology Transfer cost -Rs.15,000/-

Battered and Breaded Products from Farmed Basa (Pangasius hypophthalmus

Technology developed by

Faculty: Dr Abhilash Sasidharan
Student team: Nino Thomas M
Department of Fish Processing Technology Faculty of Fisheries Science & Centre of Excellence in Food Processing and Packaging Technology, Kerala University of Fisheries and Ocean Studies

Introduction

Breaded and battered ready to cook products from Basa fish offers the flavour and crispy mouth-feel that consumers crave. Development of unique value-added products from *Pangasius hypophthalmus* (Basa) like mince-based ready to cook products such as cutlet, finger and balls etc is an excellent tool for efficient market penetration of the Basa fish.

Processing

Boil the deboned fish meat

Mix and saute with all the ingredients (spices and condiments)

Cool the mixture and mold to desirable shapes

Battering (batter should be at 10 °C)

Breading (20%)

Par fry at 180 °C for 30sec

Air blast freezing at -40 °C for 90 minutes

Storage in -20 °C freezer

The Product

These products are simple to prepare and cooks from frozen to fry. These are rich in protein.

Ingredients

Cutlet & Fish Ball: Deboned boiled fish, Potato, Green chili, Ginger, Onion, Pepper, Clove, Cinnamon, Turmeric, Garlic, Jeera, Chili powder, Coriander leaves, oil, Salt.

Batter mix: Maida flour, corn flour, water, salt.

The natural bread crumbs are used for breading. The batter temperature -10 ^{0}C.

Fish Finger: Fish fillets into strips of 1.5 x 11 cm.

Batter mix: Maida flour, corn flour, water, salt.

The natural bread crumbs are used for breading. The batter temperature -10 ^{0}C.

Fish Jerky

Technology developed by

Faculty: Dr. Shyni K
Student team: Ahana Vijayan, Bala G, Vishnupriya V, Anandakrishna, Dayal K
Department of Fish Processing Technology, Faculty of Fisheries Science &
Model Fish Processing plant and Training Centre Kerala University of Fisheries and Ocean Studies

Introduction

Dried fish always wins the market as the fresh one deteriorates rapidly unless we find a way to preserve it. Fish jerky is one among the dried product in which the fish meat is cut into lean strips and are marinated using organic spice mix and are dried. Jerkies can be eaten as such or can be fried and consumed. These are high in proteins and omega-3 fatty acids with a very little fat. Thus, fish jerkies is found to be a delicious snack that offers a wealth of nutritional benefits. The product should be kept in cool, dry place preferably in the refrigerator. Fish jerkies should be consumed within 6 months from the date of manufacture and once opened it should be stored air tight and keep refrigerated.

Ingredients

Tuna fish
Organic spice mix

Process flow

Clean fish and cut into lean strips of required size
Marinate using the organic spice mix
Pack and store in a cool dry place.
Dry the marinated product

Nutrition profile

Carbohydrate	:	11 gms
Protein	:	9 gms

Fish Soup Powder Using Silver carplet

Technology developed by

Faculty: Dr Devika Pillai, Dr. T. K. Srinivasa Gopal
Student team: Rabea Naz H, Gopika P J, Ammu Dinakaran, Dr Divya K Vijayan
Centre of Excellence in Food Processing and Packaging Technology, Kerala University of Fisheries and Ocean Studies

Introduction

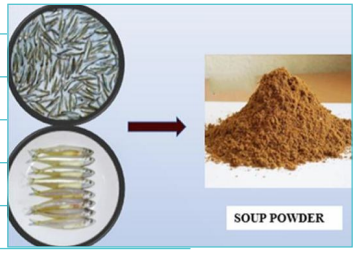
Silver carplet (*Amblypharyngodon meletinus*) is a small indigenous nutrient dense fish, an excellent source of micronutrients such as iron, zinc, calcium, vitamin A and vitamin B12, as well as fatty acids and animal protein. Its utilization can be a perfect remedy for malnutrition. Soup is a nutritious liquid meal with high nutrient density with a low energy density. Hence the development of soup powder using the whole silver carplet fish ensures micronutrient availability and contributes to its value addition.

Processing

- Wash the beheaded fish with 1% sodium bicarbonate solution
- Steam cook at for 10 min. Blend with fried ingredients to make it a thick fine paste
- Dry the whole mass in aluminum trays at 55 °C.
- Powder well to get a homogenous product.
- Soup powder is packed in airtight flexible pouches.

Ingredients

- Silver carplet fish
- Tapioca flour
- Onion
- Butter
- Salt
- Sugar
- Coriander powder
- Pepper
- Carboxy methyl cellulose
- Ascorbic acid
- Milk powder



The Product

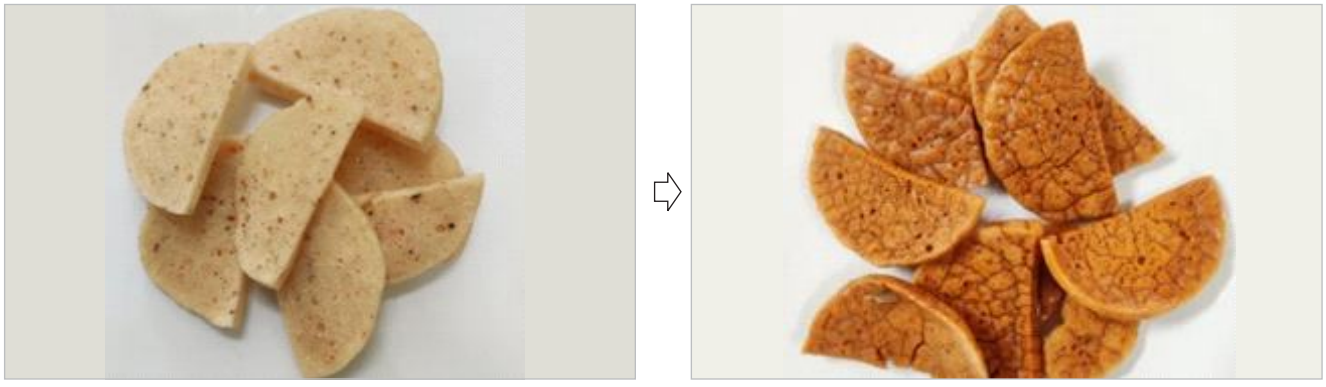
The ready-to-cook fish soup powder was vacuum packed in polyester polyethylene laminate packets. It can be stored for more than three months at room temperature.

Technology Transfer cost -Rs. 15,000/- + 18% GST

Shrimp Cracker

Technology developed by

Faculty: Dr. Shyni K
Student team: Ahana Vijayan, Bala G, Vishnupriya V, Anandakrishna, Dayal K
Department of Fish Processing Technology, Faculty of Fisheries Science &
Model Fish Processing plant and Training Centre, Kerala University of Fisheries and Ocean Studies



About the Product

In our modern era the demand for snack foods is increasing day by day. Crackers are often branded as a nutritive and convenient way to consume a staple food, especially among the younger and middle aged groups. Crackers are dried products which can be fried and eaten and also accompany other food items such as cheese, jam, butter etc. The carotenoids rich shrimp cracker was developed using shrimp as the base material along with organic spice mixes and a starch component. The combination of shrimp with organic spices without any added preservatives results in greater antioxidant properties and excellent shelf life. The crackers are relatively rich in proteins, vitamins & minerals and a great source of carbohydrates. The product should be kept in cool, dry place and should be consumed within 4 months from the date of manufacture. Once the pack is opened crackers should be used within one week.

Ingredients

Shrimp

Organic spice mix

Starch component

Process Flow

Mix shrimp, seasonings, spices and starch component to form a dough.

Boil the dough and keep it refrigerated for some time.

Cut the dough into required size and dry.

Pack and store it in cool and dry place.

Nutrition Profile

Energy	: 140 kcal
Carbohydrate	: 18 g
Protein	: 2 g
Fat	: 5 g

Bilimbi Syrup

Technology developed by

Faculty: Dr T. K. Srinivasa Gopal, Dr Maya Raman
Student team; Ammu Dinakaran, Ninisha Babu, Dr Divya K Vijayan
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Introduction

Bilimbi is a fruit that is largely cultivated in Kerala and is available in plenty but it does not have any market value or even does not have a place in the market despite its medicinal properties. In view of this an effort has been made to develop a value-added produce. Pasteurised bilimbi syrup using fresh bilimbi extracts. There are reports that can be evidenced for the use of bilimbi fruit for medicinal purposes. The fruit syrup is used for treating fever and inflammation, coughs, beri-beri, to stop rectal bleeding and to reduce the severity of internal hemorrhoids

The Product

The syrup is acidic with TSS (68° Brix) in accordance with FSSAI Standards. The product was packed in polypropylene bottles and stable at room temperature for 10 months

Ingredients

- Fresh ripe bilimbi
- Sugar
- Potassium metabisulphite

Processing

- Cut fresh bilimbi fruits into small pieces
- Steam cook the fruit along with water (1 part water:6 parts Bilimbi)
- Extract the juice
- Add sugar syrup (80 °B) and potassium metabisulphite
- Pack in clean and sterile bottles
- Pasteurization of the syrup filled bottles

Technology Transfer cost -Rs. 10,000/- + 18% GST

Fibre-rich Biscuits

Technology developed by

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Introduction

Biscuits, a flour-based baked food products are widely accepted bakery product due to its ready to consume nature, nutritional consistency and availability in various varieties and reasonable price.

Carrageenan is a natural polysaccharide obtained from red seaweeds and is a rich source of fibre. The diets rich in fibre have a positive effect on health, thus, carrageenan was incorporated into biscuits to enhance the fibre content.

Ingredients

- Refined flour
- Carrageenan (food-grade)
- Oil
- Sugar
- Salt
- Skim milk powder
- Emulsifier
- Sodium bicarbonate Ammonium bicarbonate
- Invert syrup
- Essence

Processing Method

- Dough preparation
- Leavening for 30 minutes of dough
- Molding
- Baking

Product

Biscuits incorporated with marine fiber carrageenan was developed and found to have better nutritional characteristics, antioxidative properties and consumer acceptability. Incorporation of 6% carrageenan was found to be ideal for improved fiber content and consumer acceptability. The biscuits are packed in polypropylene cups and exhibited shelf life of the 56 days at room temperature.

Technology Transfer cost -Rs. 10,000/- + 18% GST

Diet Chocolate

Technology developed by

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Introduction

Chocolate is a very popular food product that is relished by millions of people for its unique, rich and sweet taste. The health benefits of chocolate are immense which is attributed to its high levels of antioxidant components. Dark chocolates are consistently associated with better physical health, body composition and are recommended to have short-term benefits on reducing blood pressure, lower blood cholesterol and lower the risk of cardiovascular disease. It is also considered as mood enhancer and improves cognitive performance.

Ingredients

- Cocoa powder
- Jackfruit seed powder (fermentation of whole jackfruit)
- Cocoa butter substitute
- Milk powder
- Lecithin
- Sweeteners: Stevia

Processing

- Melt cocoa butter substitute
- Mix cocoa powder, milk powder, lecithin, sweetener and jackfruit seed powder
- Mix thoroughly and pour into chocolate mould
- Keep under refrigeration to solidify

The Product

Chocolates are prepared by ten percentage replacement of cocoa powder with jackfruit seed powder facilitate the utilization of the under-utilized jackfruit. The chocolates have a low glycemic index and low glycemic load. Hence, it can be a great substitute for chocolates to diabetic patients. The products were highly accepted by the sensory panel members. The product was packed in metallized polyester laminated with polyethylene pouches at room temperature. Shelf-life of the product is three months.

Technology Transfer cost -Rs. 20,000/- + 18% GST

Jackfruit Leather

Technology developed by

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Introduction

Post-harvest loss is very common in seasonal fruits due to its high perishability even under refrigerated conditions. Value addition and processing is the best solution to overcome this problem and it also ensures the availability of the product round the year. The ripened jackfruit is naturally sweet in taste is being used for many traditional preparations in the southern states of India. The fruit bulbs are also eaten as such. It is also found in the markets of Southeast Asia.

Fruit leather is a dehydrated product prepared out of fresh fruit pulp or fruit juice concentrate. It is a leather like sheet and is also known as fruit bar or fruit slab.

Packaging

The product was packed in polyester laminated with Biaxiallly oriented polypropylene packets. The shelf life of the product was three months at room temperature, stored in both packaging materials.

Ingredients

Jackfruit (*Artocarpus heterophyllus*)
Corn flour
Honey
Water
Preservative

Processing

Pressure cook the fruit bulb along with corn flour and water.
Grind the fruit along with honey to get smooth pulp
Preservative in the permissible level
Spread the pulp on trays coated with butter and dried at 52°C and 1.5m/s air velocity for 24h in a tray drier

The Product

Jackfruit leather is a nutritious energy-rich product that ensures availability during off-seasons. This is a high carbohydrate (78.3g%) product, rich in minerals (potassium, sodium, magnesium, calcium); and was widely accepted by the sensory panel members.

Technology Transfer cost -Rs. 15,000/- + 18% GST

Marine- Fiber Rich Bread

Technology developed by

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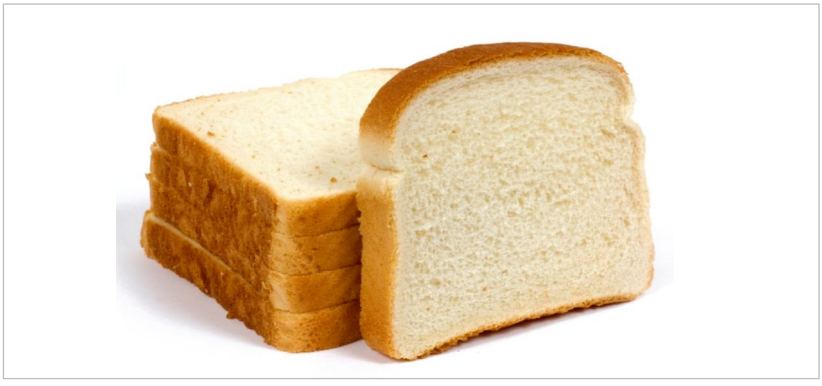

Introduction

Bread and bun are the oldest and most popular functional foods all over the world; even though, in India, it is a secondary staple food. Nutritionally, it is a good source of fibers, minerals and vitamins. It has gained considerable attention due to its nutritional and health benefits. κ-Carrageenan, a marine hydrocolloid, is a common food additive extracted from red algae. Even though, it adds no nutritional value or flavor to the food, it finds wide application in the food industry. It serves as a substitute for fat and acts as thickening, gelling and stabilizing agent. In the bakery industry, it has been reported to improve the dough stability and affects the bump area.

Major ingredients

- Flour
- Yeast
- Sugar
- Salt
- Oil
- Milk
- Vitamin C
- Carrageenan
- Water

Method processing

- Dough preparation
- Fermentation of dough
- Molding and proofed
- Baking.

The Product

Developed fibre-rich bread using the marine fibre carrageenan and The bread was packed in LDPE pouches.

Technology Transfer cost - Rs. 10,000/- + 18% GST

Multi-millet cookies

Technology developed by

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Introduction

The growing demand for healthy foods has promoted the development of a variety of high fibre, low-sugar bakery items such as bread, cookies, and cakes. Incorporation of Palm jaggery the natural sweetener as well as multi-millet flours helps to improve the health benefits of cookies with very low glycaemic index, high levels of protein, fibre and various minerals. Ragi and sorghum are gluten free. Curcumin, a natural antioxidant, make the product capable to diminish effect of lifestyle induced oxidative stress. Carrageenan is a marine algae polysaccharide also improves the fibre content.

Processing Method

Mixing the fat and ground palm jaggery to make a fine creamy paste.

Dough preparation using dry ingredients with the creamy paste of fat and palm jaggery

Knead lightly to make sure its uniformity

Moulding & Baking.

Packing

The cookies are packed in polypropylene cups and exhibited shelf life of the 9 weeks at room temperature.

Technology Transfer cost -Rs. 10,000/- + 18% GST

Product

- Protein rich (10.38%)
- High anti-oxidant activity
- Improved fiber content (2.36%)
- Low glycemic index

Ingredients

- Whole wheat flour
- Ragi flour
- Sorghum flour
- Carrageenan powder
- Curcumin
- Fat
- Palm jaggery
- Baking powder
- Baking soda

Nutrient bar

Technology developed by

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The Product

In our modern fast paced lifestyle, frequent snacking alternatives are of great demand that can replace the traditional meals. The Nutrient rich high protein bar was developed using pumpkin seed, ground nut, watermelon seed, and chia seed with palm jaggery as natural sweetener. The combination of seeds makes them low in calorie with significant levels of dietary protein, good fat (mono and polyunsaturated fats), zinc, magnesium, potassium, Iron, vitamin B2 (riboflavin) and folate. Also, they are rich source of powerful antioxidants. Palm jaggery was used as sweetening agent that helps to lower the glycemic index of the product.

The product is vacuum packed in 12-micron polyester laminated with 300-gauge polythene. The shelf life of the products was monitored to be more than 8 weeks at room temperature.

Ingredients

- Palm jaggery
- Chia seeds
- Watermelon seeds
- Groundnuts
- Pumpkin seeds

Processing Method

- Roast the seeds in a pan.
- Mix the roasted ingredients with hot palm jaggery syrup in the pan
- Spread uniformly in a tray
- Allow it to cool and cut into pieces

Technology Transfer cost -Rs. 15,000/- + 18% GST

Thermally Processed Ready-To-Eat Tomato Paste

Technology developed by

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Introduction

Tomato is an important vegetable with high commercial value. It is a rich source of Vitamin C, carotenes and other nutrients. Tomato is a seasonal crop due to which it is produced in large quantities during the harvest season and thus a huge load of the raw material arrives at the processing industries. This forces the manufacturer to process in high volumes into various products since it is highly perishable in its fresh state. This has led to the need for processing of tomato into different products in order to extend the shelf life and ensure its availability round the year also to reduce post-harvest loss. Retort processing is a thermal preservation technique which is used for the production of ready to eat processed food products in retortable pouches that are shelf stable at ambient temperatures.

Processing

- Heat oil in a pan and pop mustard seeds, black gram and red chilly
- Saute chopped garlic vacuum sealed and stored in freezer (-20 °C.
- Add finely sliced tomato and cook until form a thick paste
- Fill the curry in see through retort pouch and Vacuum seal
- Thermal processing

Ingredients

- Tomato
- Garlic
- Chili powder
- Oil
- Mustard
- Asafoetida
- Turmeric powder

The Product

The paste developed was filled in sturdy retort pouches, vacuum sealed and thermally processed (121.1°C) using steam-air retort. The F_0 value was determined to be 7.34 min. This commercially sterile product was greatly accepted by the sensory panel members. The product can be kept at room temperature for longer duration without refrigeration and without adding any chemicals.

Technology Transfer cost -Rs. 50,000/- + 18% GST

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