ACTIVITIES UNDER CENTRE OF EXCELLENCE IN FOOD PROCESSING TECHNOLOGY

PROJECTS PROPOSED DURING 2017-2018

- Established laboratory facilities under CEFPT by procuring equipments, glasswares, chemicals etc.
- Standardisation and Development of value added products from Tilapia ***(Oreochromis mossambicus)***
- Development of Multiplex PCR for the detection of virulent factors in Enterohaemorrhagic *E. coli* (EHEC) from seafood.
- Development of value added products from farmed Basa (*Pangasius sp.*) and conversion of processing waste into low cost fish feed."
- Osmotic dehydration of snake gourd with different osmolytes and its incorporation in bread.

PROJECTS UNDERTAKEN DURING 2018-19

- Development of diet chocolates by partially replacing cocoa powder with jackfruit seed powder and using natural/ artificial sweeteners containing natural stevia and sucralose
- Development of fiber-rich bakery products and incorporation of tutti-frutti from snake-gourd in breads to replace tutti fruit from papaya
- Development of Jackfruit leather
- Standardisation and pasteurisation of of Bilimbi syrup in PET bottles
- Development of ready-to-eat tomato curry in retortable pouches.
- Biofilm forming ability of isolates from fish
- Dietary supplementation of marine lipids in aquacultured shrimps for immunological studies
- Identification of virulence associated genes of various strains of Entero haemorrhagic E.coli (EHEC) and development of specific method for its identification using multiplex PCR.
- Development of value added products from farmed Basa (*Pangasius* species)

PROJECTS UNDERTAKEN DURING 2019-20

- Shelf life of ready to eat tomato curry in see through retortable pouches.
- Development of marine fibre rich bakery products like Bread, Bun and Biscuits.
- Shelf life of Jackfruit leather in different packaging materials
- Utilisation of Bilimbi fruit for the development of Bilimbi juice in PET bottles with a long shelf life
- Development of Foam mat dried powder and sorption isotherm characteristics of the product at different relative humidities
- Thermal processing of Ready to eat tomato rice in Semi rigid containers
- Preparation of Caviar substitutes using tilapia processing waste by spherification technology

- Development of Multiplex PCR for the detection of virulent factors in Enterohaemoragic E.Coli (EHEC) from seafood
- Standardisation and development of fortified and nutrious fish noodles and pasta
- Effect of nanoformulated marine lipid on Nile tilapia(Oreochromis niloticus)
- Production of tuna fish silage and calcium supplements from tuna processed wastes and characterization of nutritional quality
- Development of functional bio-based seaweed edible films for shelf life extension of fishery products and for potential food applications

RESEARCH PROGRESS (2017-2020)

The Center of Excellence in Food Processing Technology (CEFPT), Kerala University of Science and Technology (KUFOS), Panangad has envisaged to work on projects of immediate significance to agro-food processing industries and society.

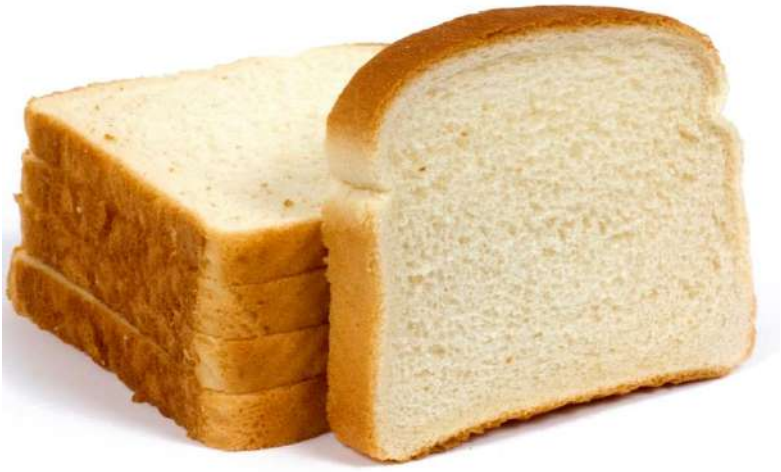
PROJECTS COMPLETED AT THE CENTER

- **Dietary supplementation of κ-carrageenan to improve the physio-chemical and functional properties of white bread.** (Paper published in Journal of Food and Nutrition Sciences)

Marine fiber rich bread was developed as a part of developing value added bakery products**.** Fiber intake improves gut health and prevents non-communicable diseases. The study was aimed to investigate the substitution of carrageenan in white bread and evaluates its effect on the physiochemical and structural characteristics on bread. The 100% wheat flour was used as control and the test sample contained 4% carrageenan. The physio-chemical analysis showed that carrageenan-substitution improved the hydration properties of the flour (WHC-1.33g/g; SC-3.50ml/g). Carrageen substituted bread also showed a decrease in the loaf volume. The fiber content in carrageenan-substituted bread was noticeably higher (9.4g%) than control (3.5g%). Crude lipid (4.6g%) and protein (7.0g%) content improved with carrageenan-substitution. The mineral contents (Na, K, Mg, Ca, Fe, and Zn) were increased in carrageenan-breads. The texture profile analysis showed a decreased hardness (H1- 92.3N, H2- 62.5N) and improved springiness (5.3mm) in carrageenan-bread. The present attempt could encourage the use of marine fibers in developing functional foods and exploiting the health benefits of these bioactive components. The use of these bioactives in composite foods will ensure nutritional efficacy and health foods for growing population.

Physiochemical properties of bread

	Control	Car-bread
Physical parameters		
pH	6.5	7.5
Loaf weight (g)	124.83	140.13
Loaf volume (ml)	150.00	130.00
Specific volume (ml/g)	1.20	0.93
Bulk density (g/ml)	0.40	0.41
Packed density (g/ml)	0.65	0.65
Water holding capacity (g/g)	1.06	1.33
Swelling capacity (ml/g)	2.60	3.50
Oil holding capacity (g/g)	1.48	1.14
Chemical parameters (g/100g)		
Moisture	28.6±0.4	29.4±0.5
Ash	1.0±0.0	1.5±0.3
Fat	3.0±0.7	4.6±0.9
Protein	6.9±0.1	7.0±0.1
Carbohydrate	17.8±0.5	15.0±1.0
Fiber	3.5±0.3	9.4±1.5[a]
Reducing sugar	5.8±0.0	6.9±0.0
Non-reducing sugar	10.7±0.0[a]	8.4±0.0
Total sugar	17.0±0.0[a]	15.6±0.0
Mineral content (µg/g)		
Sodium	2618.8	2709.6
Potassium	1452.7	2565.7
Magnesium	235.4	678.8
Calcium	254.6	277.9
Iron	51.9	63.1
Copper	3.3	1.2
Zinc	6.1	4.3
Calories (kcal/g)	1.4	1.5
Color analysis		
L*	76.4±1.0	76.7±1.0
a*	1.0±0.1	1.0±0.1
b*	18.2±0.3	18.2±0.3



- **Development of osmotically dehydrated tutti-frutti from unconventional vegetable source**

Osmotically dehydrated snake gourd were developed using blanched snake gourd cubes in sugar syrup of 40-60°Brix.. Cubes were drained and dried using fruit and vegetable dryer. The sensory evaluation showed god acceptability of the product.

- **Diet chocolates and replacement of cocoa powder with jackfruit seed powder.**(Paper published in Journal of food and nutrition sciences)

Diet chocolates were developed which was found to have a low glycemic index and the feasibility for the use of jackfruit seed powder as a substitute for cocoa powder was studied.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 polyphenolic content. In this study, diet chocolates using natural and artificial sweeteners were developed. Also, the jackfruit seed powder after fermentation (anaerobic and aerobic) was used to replace cocoa powder by 10%. The physiochemical and glycemic index of the chocolates were analyzed. The physiochemical analysis of the chocolates indicated that substitution of jackfruit seed powder did not alter significantly the proximate composition. It was found out that the glycemic index and glycemic load of the chocolates were significantly lower than commercial milk chocolate, which makes it a suitable food product for diabetic and other groups. The samples were packed in pouches made of metallized polyester films laminated with polyethylene for storage studies. Instrumental textural studies were in concordance with sensory observation, indicating that the product remained stable for 3 months at room temperature (26±2°C). The color of the product remained similar throughout

the storage period indicating stable structural and surface characteristics. Hence, the chocolates developed using natural and artificial sweeteners have low GI and will minimize the risk of several chronic diseases including diabetes and the use of jackfruit seed powder as a substitute for cocoa powder has not altered any of the characteristic features of chocolate.

Physicochemical composition of chocolates

	Control	Stevia-C	Sucralose-C	JF-control	JF-Stevia	JF-Sucralose
Moisture (g%)	2.7±0.1	3.9±0.7	4.0±0.4	3.9±0.7	4.1±0.5	3.9±0.7
Ash (g%)	4.0±0.1	4.4±0.2	4.3±0.0	2.6±0.01	4.4±0.1	4.2±0.0
Fat (g%)	55.0±0.03	56.0±0.6	58.9±0.02	51.6±0.01	57.3±0.1	58.7±0.04
Protein (g%)	7.9±0.2	10.03±0.3	10.3±0.04	7.4±0.1	8.6±1.3	10.3±0.3
Carbohydrate (g%)	30.4±0.1	25.7±0.5	22.5±0.3	34.5±0.1	25.4±0.1	22.9±0.2
Fiber (g%)	6.8±0.2	7.1±0.2	7.4±0.2	6.5±0.2	7.1±0.02	7.3±0.1
Reducing sugar (g%)	6.0±0	16.6±0	14.7±0	5.7±0	8.4±0	5.8±0
Non-reducing sugar (g%)	5.2±0	1.2±0	2.0±0	5.0±0	8.3±0	5.2±0
Total sugar (g%)	11.3±0	17.8±0	16.7±0	10.7±0	16.7±0	11.4±0
Calories (kcal/g)	6.9	6.9	7.1	6.7	7.0	7.1

Glycemic index and glycemic load of chocolates

	Stevia C	Sucralose C	JF Stevia	JF Sucralose	Commercial chocolate
Glycaemic Index (GI)	42.8±0.15	42.8±0.01	44.8±0	43.6±0.01	70.8±1.9
Glycaemic Load (GL)	13.2±0.04	12.0±0.001	12.3±0.005	13.7±0.0002	42.8±1.18

Stevia-C: Stevia chocolate, Sucralose-C: Sucralose chocolate, JF- Jackfruit

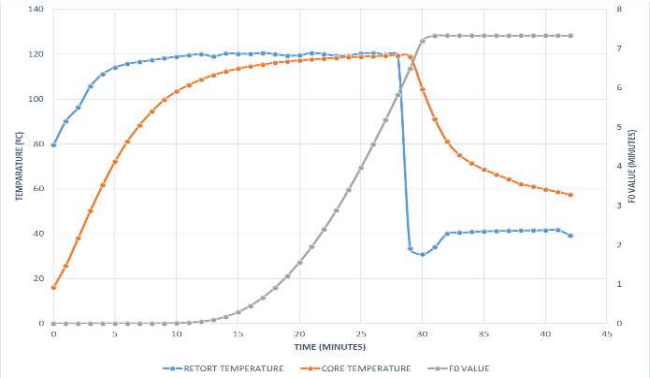
- **Process optimization for the development of shelf stable Ready to eat Tomato curry in See through retort pouch**(Paper submitted for publication in Journal of Post-harvest technology)

Tomato is a seasonal fruit that is produced in bulk quantities during the period of harvest. This leads to a glut which affects the primary producers. This scenario can be overcome only by the production of value added products that are shelf stable and can be utilized when there is a shortage. Ready to eat tomato curry in see through retort pouches was developed using steam air retort. The product was found to be commercially sterile after retorting to an F_0 value of 7.34 minutes. The heat penetration characteristics of the product was studied and revealed a total process time of 30.38 minutes to attain the above F_0 value and the cook value was 66.03 minutes. The characteristics of the see through retort pouch used for the study was analyzed and our results showed that it had good barrier properties and is suitable for food contact applications. Tomato is known as a rich source of lycopene, thus in this study the ready to eat tomato curry was also analysed to determine the changes that occurred in the lycopene content during processing. The amount of lycopene in raw tomato was 17.26µg/g and that in retort processed tomato curry was 17.20µg/g. The results indicate very minute degradation in the lycopene content due to thermal processing. In the present study tomato curry was incorporated with 10g garlic for every 100g tomato. The amount of alliin was estimated to be 665.4µg/g in Raw garlic that was used for the curry and the amount present in tomato curry was 412.27µg/g. Shelf life studies conducted revealed a shelf life of one year at ambient temperature (26 to 28°C).

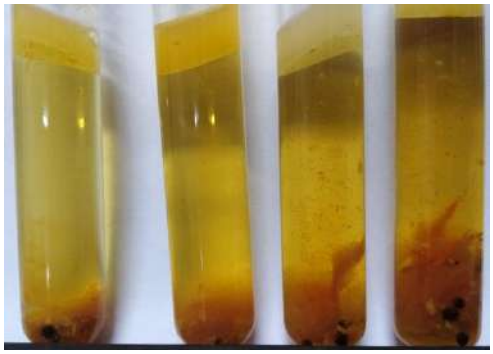
Chemical composition of tomato curry

Parameter	Amount
Moisture (g%)	73.61 ± 0.84
Carbohydrate (g%)	15 ± 0
Ash (g%)	4.40 ± 0.10
Fat (g%)	4.40 ± 0.10
Protein (g%)	2.57 ± 0.02
Fiber (g%)	3.76 ± 0.30
Reducing sugar (g%)	4.69 ± 0.05
Non-reducing sugar (g%)	4.82 ± 0.08
Total sugar (g%)	9.76 ± 0.03
Calories (kcal/g)	3.12

Heat penetration characteristics and f_0 value of tomato curry



Tubes after test for commercial sterility of tomato curry



- **Development of jackfruit leather and its shelf life analysis in different packaging materials.**

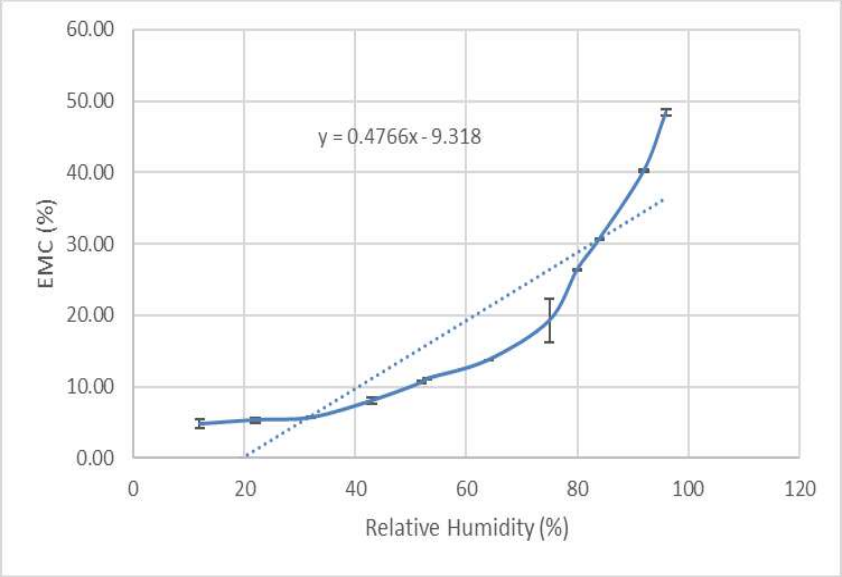
Jackfruit leather is a nutritious energy-rich product with several health benefits. Production of this product will ensure its availability during off-seasons.Jackfruit leather was developed and the characteristic studies were done, storage studies in different packaging materials revealed a shelf life of 3 months. The textural and color parameters were found to be stable for 3 months at room temperature. The jackfruit leather was found to have higher amounts of minerals like potassium and sodium. The product was highly accepted by the sensory panel members and retained natural fruit taste. The Sorption isotherm of jackfruit leather as shown in figureshowed sigmoid characteristics.The moisture sorption isotherm clearly shows that the critical moisture content of jackfruit leather is 48.39 ± 0.44% with respect to 96% relative humidity. The water activity of the product is 0.47.

Chemical Composition of Jackfruit leather

Chemical parameters (g/100g)	
Moisture	12.2 ± 0.26
Ash	3.5 ± 0.3
Fat	1.4 ± 0.4
Protein	4.6 ± 0.4
Carbohydrate	78.30 ± 0
Fibre	3.9 ± 0.4

Minerals present in jackfruit leather

Mineral Content (µg/g)	
Potassium	7442.2
Sodium	1842.1
Magnesium	869
Calcium	445.3
Iron	101.2
Chromium	10.8
Copper	4.4
Zinc	3.8
Cadmium	0.1



Moisture sorption isotherm of Jackfruit leather at room temperature

- **<u>Pasteurized Bilimbi syrup</u>**

Pasteurized bilimbi syrup was developed from bilimbi which is a highly underutilized fruit. Storage studies were conducted and it was found to be stable for more than 6 months.The syrup is acidic with TSS (68°Brix) in accordance with FSSAI Standards. It had high carbohydrate (71g %), Vitamin C (17.1 g %) and potassium (3.6mg/100g).

Physiochemical characterization	
pH	3
Total soluble solids (°Brix)	68
Titratable acidity (% oxalic acid)	2.5
Moisture (g%)	27.9
Ash (g%)	0.1
Fat (g%)	0.4
Protein (g%)	0.7
Carbohydrate (g%)	70.9
Fiber (g%)	3.8
Vitamin C (g%)	17.1
Minerals (mg/100g)	
Potassium	3.6
Magnesium	0.3
Calcium	0.7
Copper	2.6
Iron	0.1
Calories (cal)	290

- **Development of Fibre rich biscuits**

Biscuits incorporated with marine fiber carrageenan extracted from*Kappaphycus alvarezii* was developed and found to have better nutritional characteristics and consumer acceptability. The storage studies revealed a shelf life of 56 days at room temperature when packed in polypropylene trays. Fiber content increased with the increase in carrageenan content and 6% carrageenan content was found to be ideal. Sweetness of the biscuits decreased with increase in carrageenan content.Biscuits had high anti-oxidant properties than control due to the presence of marine fibers.

Proximate composition of fibre rich biscuits

Proximate composition	Control	Car-2%	Car- 4%	Car- 6%
	g/100g			
Moisture	1.35 ± 0.43	0.49 ± 0.01	1.48 ± 0.26	0.81 ± 0.06
Ash	0.74 ± 0.03	1.16 ± 0.006	1.69 ± 0.07	2.23 ± 0.17
Fat	17.51 ± 1.44	20.48 ± 3.89	25.97 ± 0.37	17.37 ± 1.22
Protein	5.98 ± 0.09	6.18 ± 0.21	6.03 ± 0.12	6.28 ± 0.01
Carbohydrate	74.42	71.69	64.83	73.31
Fiber	13.61 ± 1.98	15.78 ± 0.84	17.63 ± 1.65	20.57 ± 0.59

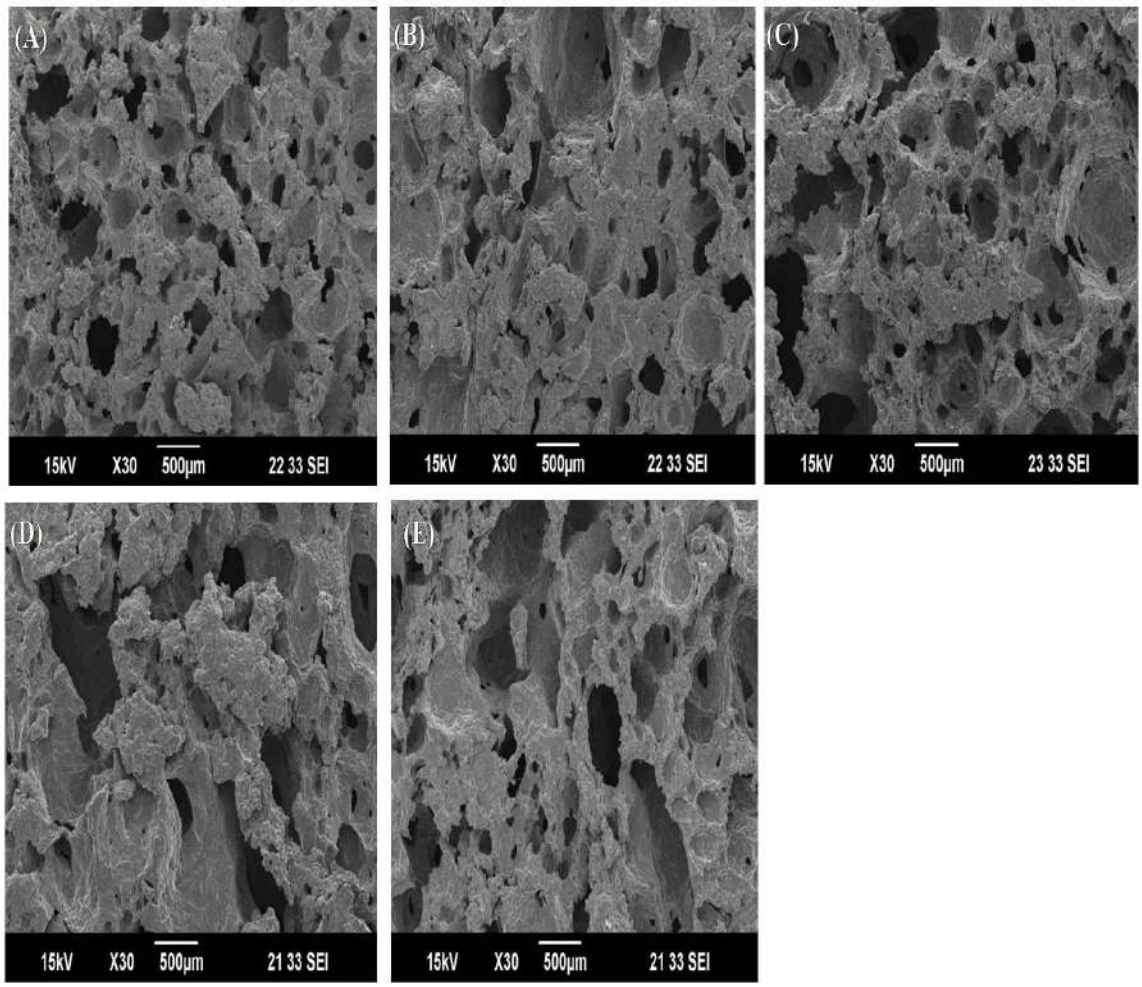
PROJECTS ONGOING AT THE CENTER

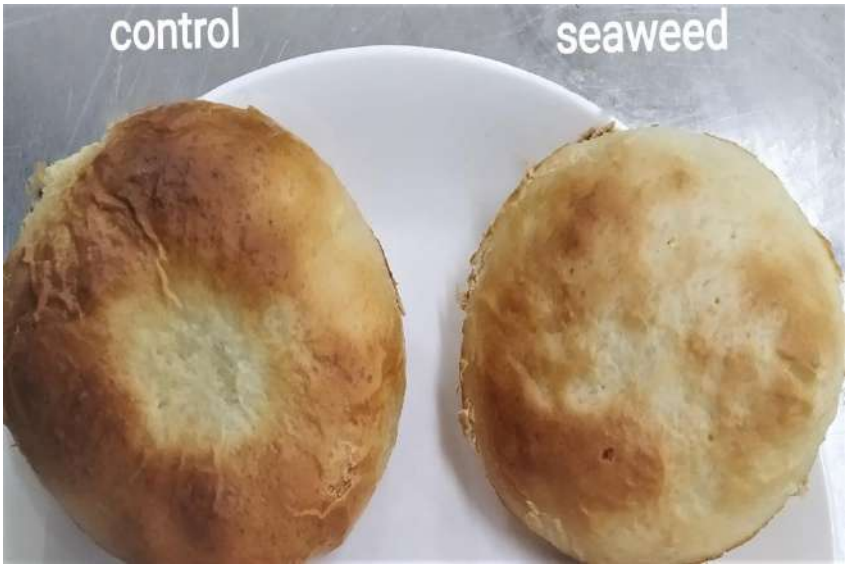
DEVELOPMENT OF FIBER RICH BUN

As a part of the objective taken up by the center to develop marine fiber rich bakery products an effort was taken to develop fiber rich buns. The center has successfully developed marine fiber rich bread and the work was published in Journal of Food and Nutrition Sciences. Marine fibre rich biscuits were also developed. The composition for the bun developed is given below.

Composition	Fiber rich bun				
	Control	Carrageenan-2%	Carrageenan-4%	Carrageenan-6%	Carrageenan-8%
Flour (g)	100	98	96	94	92
Carrageenan (g)	0	2	4	6	8
Sugar (g)	30	30	30	30	30
Salt (g)	1	1	1	1	1
Skim milk powder (g)	2	2	2	2	2
Calcium propionate (g)	0.5	0.5	0.5	0.5	0.5
Yeast (g)	3	3	3	3	3
Fat (g)	3	3	3	3	3
Water (ml)	50	50	50	50	50

Scanning Electron Microscopy was performed to analyze the morphological changes due to incorporation and increase in the concentration of Carrageenan. SEM micrographs (30X) of bun incorporated with κ-carrageenan in 4 different concentrations (A) represents Control, (B) 2%, (C) 4%, (D) 6%, (E) 8%. Control group has both small and large pores and distribution is not homologous, coalescence of pores and formation of channel like structures in group D & E.





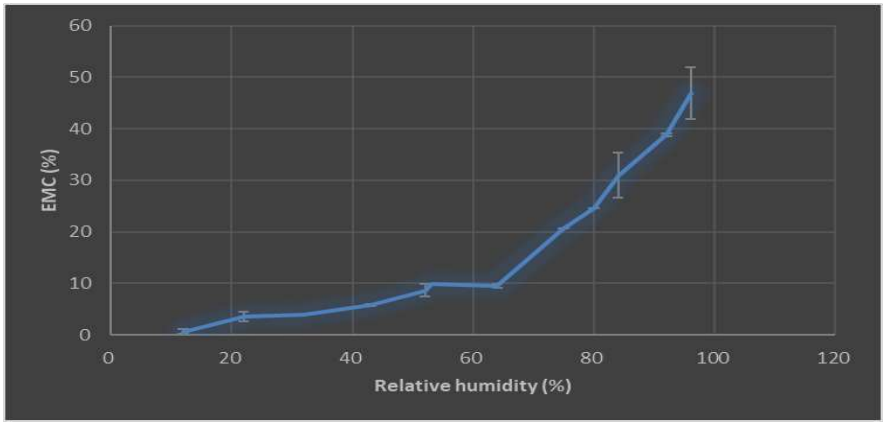
DEVELOPMENT OF FOAM MAT DRIED TOMATO POWDER

Foam dried tomato powder was developed. This is a product that can be reconstituted as tomato juice and used as a replacement for fresh tomato in tomato based preparations. It ensures the availability of processed tomato products throughout the year.

The ingredients used for the development of tomato powder is given below.

Composition	Weight
Tomato	100g
Carboxy methyl cellullose	0.75g
Egg white	4.5g

Sorption isotherm studies were done to ensure the stability of the product in different conditions of relative humidity and it showed that the product has a low water activity of 0.35 and critical moisture content of 46.86% with respect to 96% RH.



DEVELOPMENT OF READY TO EAT TOMATO RICE

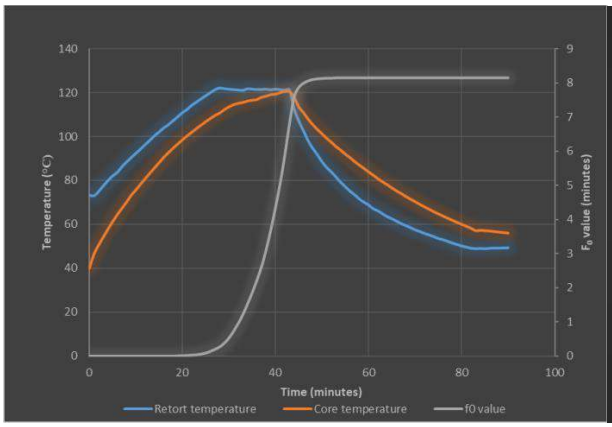
Studies were initiated for the development of ready to eat tomato rice in semi rigid containers. Thermal processing was done using water immersion retort and trials were carried out to standardize the recipe and F_0 value of the product required for commercial sterility.

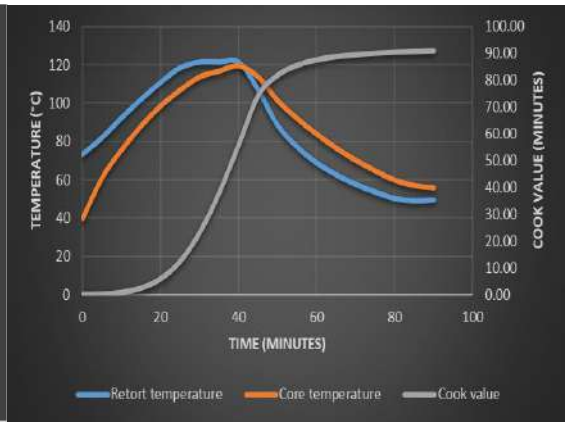
The standardized composition of the product is given below.

Ingredients	Quantity
Rice (g)	1000g
Oil (g)	142.85
Onion (g)	357.14
Tomato (g)	1000g
Ginger (g)	35.71
Garlic (g)	57.14
Chili powder (g)	28.57

Turmeric powder (g)	3.57
Salt (g)	71.43
Spices (cinnamon, cardomom, pepper, cloves) powder (g)	10.71

Heat penetration characteristics of the product with respect to F_0 value and cook value are given below.





FACULTY RESEARCH

DR. ABHILASH SASHIDHARAN

Development of value added products from farmed Basa (Pangasius sp.)

Raw pangasius fish purchased from local market was boiled with in water with 10%salt and meat meat separated. The smashed meat was mixed with other ingredients and after shaping, battering, breading and par frying, the cutlets were blast frozen to the core temperature of -35°C packed in thermoform trays and stored at -20°C. The products are analysed once in 15 days for a period of 6 months. The cutlets were deep-fried in sunflower oil until they were cooked. Sensory quality of Pangasius fish cutlets were evaluated using a nine point hedonic scale (1-dislike extremely to 9-like extremely) for product acceptability. The cutlets showed a

moisture content of 54%, 26% fat and 16 % protein and demonstrated a good shelf life upto 75 days. Organoleptic evaluation did not show any major deviations from the day of production.

Development of analogue product for caviar from Tilapia

Spherification is a process that converts liquids into squishy spheres, which visually and texturally resemble roe. Since caviar is very costly, it is not affordable to the common people. Thus, an analogue product resembling caviar was prepared. The fish used for this purpose was *Oreochromis niloticus,* commonly known as Tilapia. The caviar analogue prepared was pasteurized for better shelf life. Pasteurization was done at 71.1ºC and 86ºC. Better acceptability was obtained for the one pasteurized at 71.1ºC during sensory analysis. Shelf life analysis and microbiological analysis are being carried out.

DR. BLOSSOM K

Standardization and development of fortified and nutritious fish noodles and pasta for fighting malnutrition

Noodles with different base flours namely wheat, Rice, Ragi, Soya, Barley and Corn were treis with and without fish using a Kitchen Aid equipment. The dough after conditioning for one hour was extruded using a kitchen extruder to make sheets and strands of noodles. It was found that the noodles with combination of flours other than wheat were breaking during the sheet formation due to poor physicochemical properties. The noodles thus prepared were oven dried at 45^{o}C for 24 hours. The standardised wheat noodles were incorporated with different proportion of Tilapia fish (5%, 10%, 20%, 30%) and noodles were prepared using the same procedure. The composition and organoleptic evaluation viz., odour, taste, texture and overall acceptability, were assessed by a panel of 5 -7 judges using a 9-point of hedonic scale. The fish noodles with 30% fish had a higher sensory score. Proximate composition showed a moisture content of 9.76%, protein content of 21% and fat content of 1.9%.

DR. SAFEENA M P

Multiplex PCR for detection of virulent factors in Enterohaemorrhagic E.coli from seafood: ***Virulence associated* genes *of various strains of Enterohaemorrhagic E. coli (EHEC***)

The programme envisages identification virulence associated genes of various strains of Enterohaemorrhagic E. coli (EHEC) and development of a specific method for its identification multiplex PCR. From the samples collected 21 isolates were obtained were from shrimp samples, Clam samples, Mackerel and Sardine samples and serotyping of isolates were done with the help of Central Research Institute, Kasauli and the results indicated three isolates were Serotype of O22. Antibiotic susceptibility pattern of the isolates revealed that 90% of the (19 strains) isolates demonstrated multidrug resistance to more than 5 antibiotics, whereas all the isolates (100%) showed sensitivity to doxycycline, naladixic acid, and azithromycin.

Biofilm forming ability of isolates fromfish

The biofilm forming capacity of all the isolates were checked by conventional tube method indicated the emergence of antibiotic resistance in biofilm forming E. coli in seafood from Cochin markets, which may pose future threat to develop control strategies in the fish processing industry and also pose significant treatment challenge to physicians.

DR. E P PREETHAM

Dietary supplementation of marine lipids in aqua-cultured shrimps for immunological studies

The objective of the project was to assess marine lipid and determine the safe incorporation of marine lipid in fish feed and to elucidate and characterize the immunomodulatory effects in fishes. The study investigates the in vivo and in vitro changes through immunological and Biochemical assays and delineates the immunostimulant property for application in aquaculture.

Studied the effect of alkoxy glycerol on growth performance, immune response and disease resistance in Nile Tilapia (Oreochromis niloticus)and found out it improved the growth and survival rate of speices. Also studied the effect of sea weed (Portieria

ornemani) as immunostimulant and disease resistance property in tilapia. Sea weed enriched diet improved the growth and survival rate in tilapia

TECHNOLOGIES READY FOR COMMERCIALIZATION

- Marine Fibre rich Bread and biscuits
- Diet chocolates
- Ready to eat tomato curry
- Jackfruit leather
- Bilimbi Syrup
- Value added products from farmed Basa
- Analogue product for caviar from Tilapia
- Fortified and nutritious fish noodles and pasta
- Kit for detection of virulent factors in Enterohaemorrhagic E.coli from seafood using Multiplex PCR
- Dietary supplementation of marine lipids and alkoxy glycerol as an immunostimulant for the better growth and disease resistant properties.

SEMINARS/ WORKSHOPS/ MEETINGS ATTENDED

- Professor chair Dr. T.K.Srinivasa Gopal participated in the national seminar organized by MSTM arts and science college, Perinthalmanna on "on Food processing on 12 th October 2019 and gave an invited talk on "Advances in Food Processing".

- Professor chair Dr. T.K.Srinivasa Gopal attended QRT meeting of ICAR-CIFE, Mumbai on 26 th and 27 th February, 2020

- Professor chair Dr. T.K.Srinivasa Gopal attended FSSAI meeting on packaging on 14 thFebruary,2020

- Dr. Safeena MP presented poster entitled "Molecular characterization and evaluation of antibioticsusceptibility and biofilm forming capacity of pathogenic Escherichia coli isolated from seafood" at11th IFAF (21-24 Nov 2017) , Cochin

- Dr. Blossom K.L and Dr. Abhilash Sasidharan participated in 11th IFAF (21-24 Nov 2017), Cochin.

- Ammu Dinakaran presented a paper during the 11th IFAF (21-24 Nov 2017) entitled "Developmentof ready-to-eat Indian Mackerel Rastrelliger kanagurta curry in semi-rigid containers using waterspray retort"

- Ammu Dinakaran and Akshaya Ravindran participated in the organization of International seminar during November 2017 on Recent Trends in Best Management Practices in Aquaculture at KUFOS

- Prof.T.K.Srinivasa gopal delivered a talk on Corrugated fibre board for Fish packaging during India International Seafood show during 2018 held at Goa and contributed popular article on Recent advances in packaging of Fishery products.

- Maya Raman attended the international conference and presented a paper on In-vitro binding of mutagens by wheat bran and Kappaphycus alvarezii dietary fiberFractions presented paper during the International Conference (9-10 Feb 2018) at St. Teresa's College

- Dr. Blossom KL and Dr. Abhilash Sasidharan participated in 11th IFAF (21-24 Nov 2017), Cochin.

- Ammu Dinakaran presented a paper on "Developmentof ready-to-eat Indian Mackerel Rastrelliger kanagurta curry in semi-rigid containers using water spray retort" during the 11th IFAF (21-24 Nov 2017)

- Dr.T.K.Srinivasa Gopal presented a paper on Value added shelf stable fish products (invited talk) at Indian convention of Food Scientists and Technologists conducted by AFST (Hyderabad chapter) December 2017

- Dr.T.K.Srinivasa Gopal Chaired the session on Adding Value to Fish: Avenues in Fish processing and Packaging and presented a paper on Recent advances in packaging of fish products(invited talk) during 11th IFAF held at Cochin during 22nd November 2017.

- Dr.T.K.Srinivasa Gopal attended the brain storming meeting on major challenges in Food safety invited by Information Technology Research Academy division, Ministry of Electronics and information technology, New delhi during October 2017.

- Dr.T.K.Srinivasa Gopal attended the Scientific panel on Fish and Fishery products (FSSAI) during March 17, September 2017, February 17 , June 2018, October 2018, February 2019, July 2019, November 2019 and Scientific panel on Packaging(FSSAI) during Feb 2020 at New Delhi.

- Dr.T.K.Srinivasa Gopal Chaired the session New packaging materials to address sustainability during 19th (IUFOFT) International Union of Food science and Technology World congress of Food Science and Technology held at Mumbai during 23-27th October 2018.

- Dr.T.K.Srinivasa Gopal delivered a talk on Value addition and Nutraceuticals related to Fish and Shell fish during Session 2 on Innovative approaches in Fishery Science and Techologies for desirable health attributes during October 2018 IUFOST congress held in Mumbai.

- Dr.T.K.Srinivasa Gopal delivered a talk on Innovations in Fish processing and Packaging of Fish and Fish products during February 2019 NAAS Congress held at New Delhi .

- Dr.T.K.Srinivasa Gopal and Dr.Abhilash Sashidaran attended the meeting of the core group for the promotion of life science sector in Kerala during 7th November 2019 at KSIDC office, Trivandrum

TRAINING PROGRAMME AND OTHERS

- CEFPT in association with CASRED conducted Bakers training program at KUFOS during December 2019.
- Biodegradable packaging material for fish packing wasstudied by subjecting to various physical properties and released during AQUABE international conference during November 2018
- The products developed in CEFPT was displayed during AQUABE on 27 th to 30 th November 2019

- Maya Raman, Ammu Dinakaran and Akshaya Ravindran attended one-day training (23 Dec 2017) on chocolate manufacturing at Cocoa craft, Kochi.

- Dr.T.K.Srinivasa Gopal – Convener for the International seminar on Recent trends in best management practices in Aquaculture conducted at KUFOS, cochin during November 2017
- Established Bakery Production Line which will be useful for the researchers and to conduct entrepreneurship development programmes.
- Submitted detailed plans for the establishment of meat, poultry and fish kheeema line and Fruit Squash/ Syrup production line.
- Submitted proposal for setting up Skill development/ Incubation Centre. The proposed plan is for the estabilishment of three food production lines for Kheema making, Bread, biscuit, cookies, bun and cake making, Fruit squash/ syrup making

PAPERS PUBLISHED

1. Akshaya Ravindran, Maya Raman, Ninisha Babu, Ammu dinakaran, T.V.Sankar and T.K.Srinivasa Gopal, (2020). Diet chocolates and replacement of cocoa powder with jackfruitseed powder, Journal of Food and Nutrition Sciences (2020), 11:220-233.

2. Elumalai Preetham, Prakash, P, Musthafa, M. S, Faggio, C. (2019). Effect of alkoxy glycerolon growth performance, immune response and disease resistance in Nile Tilapia(Oreochromis niloticus). Research in Veterinary Science,123, 298-304.

3. Maya Raman, Ammu Dinakaran, Akshaya Ravindran, T.V. Sankar and T. K. S. Gopal (2019).Dietary supplementation of k-carrageenan to improve the physio-chemical and functionalproperties of white bread, Journal of Food and Nutrition Sciences, 10, 8, 997-1010

4. Safeena (2020). Evaluation of sensitivity and specificity of the multiplex PCR developed for the rapid detection of E. coli O157:h7 from seafood" in International Conference on Impact of Climate Change on Hydrological Cycle, Ecosystem, Fisheries and Food Security, 2020 organized by CUSAT, School of Industrial Fisheries, Cochin, India and Department of Fisheries, Govt. of Kerala.

5. Preenanka R and Safeena M.P. Validation of multiplex PCR protocol for identification of E. coil 0157 by spiking in seafood during Aquabe international conference held during November 2019.

6. Preenanka R and Safeena submitted a research paper on "Molecular characterization and evaluation of antibiotic susceptibility and biofilm forming capacity of pathogenic Escherichia coli isolated from seafood" and submitted to Indian Journal of Fisheries during 2018

7. Dr. Maya Raman contributed an Editorial Note on "Fiber shields from colon cancer", published by ACTA Scientific Nutritional, Health, Vol 2 (3), 2018.

8. Nimisha Babu, Ammu Dinakaran, Maya Raman, Akshaya Ravindran. T. V. Sankar and T.K.Srinivasa Gopal (2020). Development of Jackfruit leather and its shelf analysis in different packaging materials. Submitted for publication to Indian Journal of Horticulture, New Delhi

9. Ammu Dinakaran, Nimisha Babu, Maya Raman , Akshaya Ravindran, T.V.Sankar and T.K.Srinivasa Gopal . Process optimization for the development of shelf stable ready to eat tomato curry in see through retortable pouches (2020). Submitted for publication in Journal of Post harvest technology

10. Divya K.Vijayan, T.K.Srinivasa Gopal and T.V.Sankar. Effective utilization of Fish processing wastes as an Excellent source of Industrial enzymes: Isolation, Purification and Characterisation(2020). Review article submitted for publication in Waste and Biomass valorization (Springer journal)

AWARDS

- Dr.T.K.Srinivasa Gopal received Lifetime Achievement Award for outstanding contribution to Food Science and Food Technology , IUFOST Mumbai 2018 Congress

- Ammu Dinakaran received Best oral presentation award for the scientific paper on Development of ready to eat combination meals from cassava(M*anihot esculenta crantz*) and Sardine (*Sardinella longiceps*) during 19th World congress on Food

Science and Technology , IUFOST 2018 held at Mumbai during 23-27th October 2018.

- Preenanka R won Best poster award for “Development and validation of multiplex PCR for the simultaneous detection of six virulent genes of *E. coli* O157:h7 from seafood” in International conference on Aquatic resources and Blue economy (AQUABE)- 2019, organized by KUFOS.