Annexure III

FINAL REPORT OF THE WORK DONE ON THE MAJOR/MINOR RESEARCH PROJECT

1. Project report No. 1st/2nd/3rd/Final : **Final**

2.UGC Reference No. : F.NO. **32-458/2006(SR) dated06.03.2007**

3. Period of report : from Ist April **2007-31st March2010**

4. Title of research project :***Nutrient and Therapeutic value of instant seaweed mixes from seaweeds collected from biospheres of Gulf of Mannar***

5. (a) Name of the Principal Investigator : **Thahira Banu.A**

(b) Deptt. and University/College where work has progressed

Department of Home Science, Thassim Beevi Abdul Kader College For Women Kilakarai, Affiliated to Alagappa University, Karaikudi.

6. Effective date of starting of the project : **1.04.2007**

Grant approved and expenditure incurred during the period of the report:

a. Total amount approved : **Rs. 4, 96,400**

b. Total expenditure : Rs. **5, 05,713**

c. Report of the work done : **(Annexure I)**

i. Brief objective of the project : **(Annexure II)**

ii. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication **(Annexure III)**

V. If project has not been completed, please indicate the approximate time by which it is likely to be completed. A summary of the work done for the period [Annual basis] may please be sent to the Commission on a separate sheet……..

vi. If the project has been completed, please enclose a summary of the findings of the study. Tow bound copies of the final report of work done may also be sent to the Commission:

[Annexure I]

vii. Any other information which would help in evaluation of work done on the project. At the completion of the project, the first report should indicate the output, such as (a) Manpower trained (b) Ph. D. awarded (c) Publication of results (d) other impact, if any

One Ph.D submitted to Avinashilingam Deemed university for award of the degree in the month of march 2011.The publications in journals and conference proceedings are given in Annexure III

Signature of the Principal Investigator **Registrar/Principal**

Signature of the Co-investigator

PUBLICATIONS

A.Thahira Banu	Acceptability of Enteromorpha tarta incorporated recipes	Journal of Seaweed Research Utilization and association	1	133-137	Jan 2007 -08
A.Thahira Banu	Phtyochemical and antioxidant activity of green seaweeds	Indian Journal of Nutrition and Dietetics,	Vol.47, No.521	521-527	Dec 2010
A.Thahira Banu	Invivo and invitro antioxidant activity of value added seaweed products	Journal of Seaweed Research Utilization and association	Communicated		

Conferences Proceedings in which the work has been presented and published

Thahira Banu .A	3rd Indo-Korean Joint Seminar on Medicinal Plant Research	23rd Feb 2010	Department of Biotech & Bioinfo Avinashilingam Deemed University, Coimbatore	Antioxidant activity of Green seaweeds	Participated and present a paper
Thahira Banu .A	Asian Congress of Dietetics	10 – 12 Nov 2010	Thai Dietetic Association Bangkok, Thailand	Invitro and Invivo Antioxidant Activity of Seaweed Extract and food products	Published Paper Journal of the Thai Dietetic Association Vol. 30, No 3 (Sept – Dec, 2010) ISSN 0859-5232
Thahira Banu .A	National Conference on " Wholesome Nutrition: Challenges, Scope and Management"	19th-20th Nov 2010	Nutrition Society of India, Mumbai chapter.	Antioxidant and antibacterial activity of selected seaweeds	Participated and present a paper
Thahira Banu .A	National Conference on "Healthy Heart for a Healthy Living"	18th-19th January 2011	Dept. of Food Science and Nutrition Avinashilingam Deemed University, Coimbatore	Cardio protective activity of seaweed incorporated products	Participated and present a paper
Thahira Banu .A	National Conference on "Biodiversity: Richness, Uses, Threats and Conservation".	19th-21st January 2011	Dept, Of Biology, Gandhigram Rural Institute.	Mari culture a potential mode for conserving Biodiversity	Participated and present a paper
Thahira Banu .A	International Conference on "Food and Nutraceuticals For Nutrition And Health : Technology And Delivery"	20th -22nd January 2011	Dept. of Food Science Periyar University, Salem	Value addition in food products using seaweeds	Participated and present a paper
Thahira Banu .A	UGC Sponsored National Conference On "Occupational Health and Stress"	25th-26th February 2011	Dept. of Home Science, Gandhigram Rural Institute	Natures passionate stress reliever - Seaweeds	Participated and present a paper and published with ISBN No

iii. Has the progress been according to original plan of work and towards?

achieving the objective. if not, state reasons

Yes, Due to release of late funds of the IInd installment the plan of work were not progressing according to the plan.

iv. Please indicate the difficulties, if any, experienced in implementing the

project__-_____

Annexure I

REPORT OF THE WORK COMPLETED

Globalization has led to healthy living consciousness in the most recent years. Eating trends of natural food sources have been augmented to bring health and vitality and one such natural resource is seaweeds. Seaweeds offer untapped plethora of health benefits. The long recognized traditional health benefits of certain seaweeds are now being confirmed by modern scientific research and seaweeds are being used for its rich nutrient content and antioxidant property in treating major degenerative and deficiency diseases. Though seaweeds are consumed extensively by Indonesians, Japanese and Koreans who have understood the nutritional properties, valuable health benefits of these seaweeds are yet to be completely exploited by Indians. It is reported that seaweeds like *Ulva lactuca, Ulva reticulata, Enteromorpha intestinalis, Acanthophora spicefera, Gracilaria edulis, Padina tetrastomatica and Sargassum wightii* are highly concentrated in the coastal belt of Gulf of Mannar, Rameswaram to Kanniyakumari, Tamil Nadu. They are available throughout the year and can be stored for long periods in dry form. The country is now facing a double burden of deficiency as well as degenerative diseases on one side there are reports of high incidence of oral cancer which is observed in Indian sub continent accounts for the third of the world burden the risk is still high particularly in rural areas. The other sides 60-70 percent of the adolescents are reported to suffer from iron deficiency anemia. Thus Fresh, natural and minimally processed foods along with safety and quality have become the prime factor in selection of healthy foods and hence natural food adjuncts or a functional food ingredient in the modern day is needed.

Hence the present study entitled “Nutrient Composition, Antioxidant Activity and Therapeutic use of Selected Seaweeds” was undertaken with the objectives to study the morphological characteristic of selected edible seaweeds, analyse the nutrient composition, assess the microbial content and evaluate the toxicology of the selected seaweeds. Find the antioxidant and antimicrobial properties of the seaweed selected after

the toxicological evaluation develop value added products with seaweeds and study the invitro iron bioavailability and antioxidant activity and assess the therapeutic effect of value added products among selected anaemic adolescent girls and pre malignant oral cancer adults were the other objectives framed for the study.

Four seaweeds namely one brown (*Padinatetra stomatica),* one red (*Acanthophoraspicefera*) and two green (*Ulva lactuca and Ulva reticulata*) were collected from Pamban and Thonithurai the two important coastal zones of Gulf of Mannar, where seaweeds are abundantly seen. Sea weeds were collected fresh with the help of sea divers trained in handpicking these seaweeds. The collected seaweeds were thoroughly cleaned washed and shade dried. The morphology, nutrient composition namely proximate composition, mineral and vitamin composition, heavy metal and bioactive compounds were analysed using standard procedures.

The seaweeds were subjected to microbial analysis namely total bacterial count and test for presence of E.coli, salmonella, bacillus and pseudomonas. Toxicological evaluation was carried out by conducting acute and sub acute toxicological studies using animal model and safety for consumption was studied. The two green seaweeds Ulva lactuca and Ulva reticulata of the total four were found to be safe even at higher levels of dosing 5000mg/kg body weight at single dosing for rats after the toxicological evaluation and hence were selected.

Antioxidant activity and antimicrobial activity was carried out for the two seaweeds. Antioxidant activity was carried out by DPPH radical scavenging method and butylated hydroxyl toluene was used as the standard. Common food pathogens namely *Staphylococcus aureus, Salmonella typhi, Escheria coli, Psuedomonasaeruginosa,Shigelladysenteriae,Vibriocholerae,Psuedomonas mirabilis and two fungi namely Candidamirabilis and Candida. Tropical is* were tested. Chloramphenicol and miconazole were used as standard for antibacterial and antifungal activity respectively. The estimation of the Minimal Inhibitory Concentration (MIC) was carried out by the broth dilution method.

Value added products were developed using the two green seaweeds namely Ulva lactuca and Ulva reticulata, which were found to be safe. Seven recipes each incorporating Ulva *lactuca and Ulva reticulate* in the levels of (2.5 and5g) respectively were developed. The products which were convenient to prepare were developed. Tomato soup, vegetable soup, tomato spread, seaweed tea, chocolate, nutrient ball and bun were the recipes selected. The recipes were standardised and subjected to consumer acceptability by one hundred students belonging to a private college selected for the study. Scores were allotted for the attributes like appearance, colour, texture/consistency, flavour and taste. The product with the highest score for overall acceptability was selected for supplementation. Five gram Ulva lactuca incorporated seaweed tea and five gram Ulva reticulata incorporated seaweed chocolate were taken for supplementation.

Prior to administration of the value added products namely seaweed tea and seaweed chocolate the nutrient, phytonutrient, invitro iron bioavailability and invivo antioxidant activity was studied.

Nutrients content namely protein, lipid, carbohydrate and Iron was analysed. The energy value was computed using the nutritive value of Indian foods. In vitro iron availability was estimated for Ulva reticulata extract, plain chocolate, U.Reticulata incorporated chocolate separately.

A universal population of 500 adolescent girls in the age group of 15-18years studying in a private college at Kilakarai, Ramanathapuram district was selected to screen for anaemia. The classification WHO, 2001 criteria was used to categorize the mild, moderate and severe anaemic students. From those students who were moderately anaemic 100 adolescent girls were selected by purposive sampling. The girls were divided into two with each fifty subjects as control and experimental. The socioeconomic and nutritional status was assessed for all the selected subjects. The experimental group received variation II seaweed chocolate consisting of Ulva reticulata daily for a period of 120 days. The seaweed Ulva reticulata was found to be rich in iron content with 56 mg/100gm and hence was selected to be supplemented for anaemic adolescent girls. The

control group received 15gm chocolate without the seaweed. Before supplementation all the subjects were dewormed and biochemical analysis were carried out on the initial and final day for all the biochemical parameters like haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin, red blood cell, white blood cell, total iron binding capacity, serum iron and serum ferritin. Haemoglobin test alone was carried out for all the samples on the initial, 30th and 120th day.

Before the seaweed tea was administered to the subjects to find out the impact on therapeutic effect it was subjected to phytonutrient analysis the following were analysed poly phenol, chlorophyll, tannins and beta carotene. The seaweed tea was subjected to invivo antioxidant activity on animal model .Rats were randomly divided into five groups of six animals each and supplemented with 0.5,1.0,1.5 and 2.0ml/kg body weight of seaweed tea and vitamin C was used as a standard (3.0ml/kg body weight) and saline as control were fed to rats for a period of 20 days. After a period of 20 days the blood from the animals were drawn and tested for antioxidant enzymes superoxide dismutase, Lipid peroxidase, catalase and glutathione.

The seaweed tea showed a remarkable antioxidant property thus the product was administered for adult with precancerous lesions. In order to identify the patients community health camp was organized in a private hospital, Kilakarai and patients were reviewed by an oncologist. Among the 650 beneficiaries 40 male subjects showed signs of dysplasia (Abnormal development or growth of tissues, organs, or cells) and from the forty, thirty subjects who were willing to participate in the study were selected.

Adults with precancerous oral lesions were males in the age group of 35-40 years and were divided into two 15 as experimental and 15 as control.

Seaweed tea was given for the experimental group and plain black tea was given for the control group containing100ml/day for a period of 30 days was given to both the groups. The bio chemical parameter like haemoglobin, serum iron, red blood cells, white blood cells, serum glutamate pyruvate transaminase and serum glutamate oxaloacetate transaminase, alkaline phosphatase, catalase and super oxide dismutase was studied on

the initial and final day of supplementation. In addition to the biochemical results the lesions were reviewed by the oncologist for any change in the appearance of the lesions.

The findings of the study are summarised below

Morphological characteristics, nutrient composition and microbial content

- The observed morphological characteristics of the selected edible seaweeds showed that, Padina tetrastomatica of brown algae is a dark brown coloured, fan shaped seaweed with several thick lines on the thallus with leathery and course texture, always seen attached to corals.
- Ulva lactuca of green algae is a bright green sheet and silky to touch. The shapes of ulva lactuca is quite variable, but almost observed as circular or oval with waved margins and has few holes in its blade and are free floating.
- Ulva reticulata of green algae is a grass green flat blade of long strips with distinctive holes. It looks more like a filamentous spring. This seaweed is mostly observed as free floating.
- Acanthophora spicefera seaweed grows in upright clumps of spiny branches.It is pale yellow, brownish, dark green or reddish. Grows on the reef in intertidal regions.
- The proximate nutrient compositions of the selected four seaweeds it was found that Acanthophora spicefera had the high amount of carbohydrate of 28 g and Padina had the lowest of 8.8g. The protein content of the four seaweeds ranged from 27-37.6 g/100 g with Padina tetrastomatica having the high amount of protein(37.6g) followed by Acanthophora (34g) Ulva lactuca (29g) and ulva reticulata (27.4g).
- Lipid content of the seaweeds was found to be in the range of 0.4 to 5 gm with the least amount in Padina (0.4g) and the highest amount in Acanthophora spicefera(5g).
- The fiber content was high in Padina tetrastomatica with 45g and Acanthophora spicefera with 37g, followed by Ulva lactuca and Ulva reticulata with 31 and 29g respectively.
- Micronutrients like iron (50.3mg), calcium (81.6mg) phosphorous (12mg), sodium (32mg) zinc (1.9mg) and selenium (3.2g) was high in Ulva reticulata followed by

Ulva lactuca. Vitamin C was high (32.4mg) in Ulva lactuca followed by Ulva reticulate (31mg).Padina tetrastomatica had beta carotene 9µg and Ulva lactuca had 7.45µg.

- The heavy metals composition for mercury, lead, arsenic and cadmium was at a very low concentration which was below detectable level (BDL)
- Bioactive compounds present in the selected four seaweeds showed the presence of various fractions of fatty acid and plant alcohol like A- Hexadecanoic acid, phytol, linoleic acid, tetradecanoic acid, 9- octadecenoic acid, A-Decanoic acid and 1,2-Benzene dicarboxylic acid.
- The total bacterial count of the selected seaweeds was low in Ulva lactuca with 22 cfu/100gm and the highest colony count among the four selected seaweeds was observed in Acanthophora spicefera with 65 cfu/100gm.The qualitative analysis of the selected seaweeds revealed the absence of E.coli, Salmonella, Bacillus and pseudomonas. On storage the bacterial count was decreased in all the seaweeds.

Toxicological Results, Antioxidant and Antimicrobial Activity

- Acute and subacute toxicological evaluation was done to find the safety of seaweeds for human consumption
- Clinical sign of toxicity on administration of single dose of seaweeds orally to animals at 2000mg /kg body weight was observed. Among the selected seaweeds Padina tetrastomatica and Acanthophora spicifera had caused mild excitement in the animals, at 2000mg dosing, whereas the two green seaweeds Ulva lactuca and Ulva reticulata administered animals showed normal behavior and clinical signs.
- Administration of seaweeds orally to animals at higher dosing of 5000mg/kg the body weight showed that Padina tetrastomatica and Acanthophora spicifera had caused mild to severe depression in the animals during the first two hours and though the animals exhibited a normal behavior after this period these two seaweeds were not selected for further research.

- The two green seaweeds Ulva lactuca and Ulva reticulata showed a normal behavior from the time of dosing till the final day of observation. Hence green seaweeds were considered safe even at higher dosing levels of 5000mg/kgbw and therefore were used for further research.

Sub acute toxicity

- Physical changes were observed in the animals after 60 days of supplementation. In all the three groups the animals were found to be active, consumed food and water normally and had normal body temperature. There was no adverse change in the rats.
- The total ferritin levels were comparatively high in seaweed administered animals with 119±3.60 and 131.67±2.08 as against 111.3±3.21 of control group. The serum iron was increased in Ulva reticulata supplemented animals (121.67±2.08) than control and Ulva lactuca supplemented animals.
- Minerals like sodium, potassium, chloride, phosphorus, calcium and magnesium, which increased from that of control groups. The increase in mineral content in Ulva reticulata supplemented animals may be attributed to the high mineral content naturally present in the seaweeds
- The serum marker enzymes such as SGOT, SGPT and ALP were found to be within normal limits in both the seaweed supplemented groups.
- Normal blood parameters were seen in seaweed supplemented rats and this was a positive indication that these natural foods are safe for human consumption.

Antioxidant and Antimicrobial activity

- The results of the antioxidant activity of the seaweeds indicate a positive DPPH radical scavenging, for both *Ulva* extracts as 72 and 78 per cent for lactuca and reticulata respectively against the control BHT (butylated hydroxyl toluene) with 60 per cent scavenging activity which points out the antioxidant activity of the seaweed extracts.

- The investigations on ethanol extracts of Ulva lactuca and Ulva reticulata showed maximum activity against *Staphylococcus aureus* (15.0±0.50) Methanol extract of Ulva lactuca obtained maximum activity against E.*coli*(11.07±0.30) and V.Cholerae . The antifungal activity of ethanol extract of Ulva lactuca seaweed showed maximum activity against C.albicans (15.07±0.36) and Ulva reticulata (12.07±0.40).
- The zone of inhibition with methanol extracts for Ulva lactuca was high in C. albicans (15. 0±0.36) and Ulva reticulata showed maximum activity against C.tropicalis(17.0±0.50).Both the seaweeds showed minimum inhibitory concentration at 250mg/ml concentration of extracts.

Value Added Products with the Incorporation of Green Seaweeds-Acceptability of the Products

- Seven products developed with seaweed and tested for consumer acceptability showed highest overall acceptability score for seaweed chocolate (24) made with 5gm incorporation of seaweed Ulva reticulata and seaweed tea incorporated with 5gm of Ulva lactuca with scores of 23 as against a maximum score of twenty five.

Nutrient Content and Invitro Iron Bioavailability of Seaweed Chocolate

- The Seaweed chocolate was found to have carbohydrate (30g), fat(8.9g), protein(10.9g) and 163kcal of energy content. The iron content of chocolate was 56.24mg.
- The invitro iron bioavailability was found to be high in seaweed chocolate with bioavailability of 21 per cent. Thus seaweed chocolate was selected for supplementation to anaemic adolescent girls.

Impact of Seaweed Chocolate on Anaemic Adolescent Girls

- The selected adolescent girl's were in the age group of 15-18yrs the majority (48%) being in the 15-16year group.

- The pubertal age of 11 years was seen commonly among the selected girls and 54 percent reported of irregular periods.
- From the BMI of the selected adolescent girls it was found that 15 girls were underweight and 80 percent of the girls were in the 5^{th} to 50^{th} percentile and only 5 girls were in the 85^{th} percentile indicating that they have a risk of overweight.
- The meal pattern of the selected girls showed that sixty six percent of them were non-vegetarians, nineteen percent were ova-vegetarian and fifteen percent were vegetarians.
- Mean nutrient intake of the selected adolescent girls indicated that a deficit intake of energy, protein, calcium, iron, beta carotene and vitamin C when compared to that of the RDA.
- Clinical signs observed showed dry hair, pale eye pallor, dry skin and dryness of mouth all these signs are related to iron deficiency and the selected girls showed clinical symptoms of anemia.
- The impact of seaweed chocolate on hemoglobin levels of the selected girls at 30^{th} day showed that haemoglobin levels increased gradually in the experimental group after 120 days which was increased from 8.53±0.27 to 9.60±0.59.
- Mean corpuscular volume and mean corpuscular hemoglobin of the selected adolescent girls in control and experimental groups was assessed and was found to have a significant difference between initial and final mean MCV and MCH.These results may be due to the fact that seaweeds are not only rich in iron but they are also rich in micronutrients that are required for maintenance of blood volume.
- A comparable increase in RBC count(1.1) in experimental group than the control group (O.7).
- Mean white blood cell count of the selected subjects before and after supplementation was seen and found that there was a considerable increase in WBC(O.9) in the experimental group than the control group(0.3).This indicates that seaweeds can act as immune enhancers.

- Impact of total iron binding capacity on the supplementation of seaweed chocolate to anaemic adolescent girls revealed that there is a significant increase in TIBC levels of the experimental group than the control group. The TIBC levels increased from 397.84± 18.1- 423.38±12.36 in the experimental groups. The results prove that there is significant difference ($p<0.01$) between the initial and final mean values of TIBC levels in experimental groups alone.
- Supplementation of seaweed chocolate also improved the serum iron and ferritin status and there was a significant difference ($p<0.01$) between initial and final values of serum iron and serum ferritin levels.

Phytonutrient and InvivoAntioxidant Activity

- The results of the phytonutrient andinvivo antioxidant activity of the developed value added Ulva lactuca incorporated seaweed tea had phytochemicals namely polyphenol(140mg),chlorophyll (0.273mg) tannins(52.5mg) and beta carotene (0.666IU). The antioxidant activity of seaweed tea on enzymes namely, catalase, glutathione and super oxide dismutase revealed that among the four variations in the amount of tea supplementation catalase, glutathione and superoxide dismutase activity was maximum for seaweed variation A_4 (2.0ml/kg body weight) was (130±4.96,11.55±0.64 and 20.15±1.06) than in other seaweed tea variations.
- The lipid peroxidase levels were low in the standard supplemented Vitamin C (1.16±0.07) treated group followed by 2ml seaweed tea (1.77±0.058) supplemented group. All the seaweed tea supplemented rats a showed low levels of lipid peroxidase levels compared to the control group, which showed 2.90± 0.07.

Impact of Seaweeds Tea on Precancerous Oral Lesions

- The selected 30 male subjects majority (17) of them were in the age group of 40-45years.

- Twenty four of the selected males with precancerous oral lesions were in the nuclear family system and six were in the joint family system
- The monthly income of seventeen subjects was Rs1000-4000 and for eight subjects it ranged from Rs 4000-8000. Fishing was the major occupation of the subjects.
- Data on the lifestyle habits of the selected subjects revealed that tobacco was used by all in some form either as cigarettes/beedisor chewing tobacco
- Twenty three out of the selected thirty were under the normal BMI category in both the experimental and control groups. Six and one were at risk of grade I and II obesity respectively.
- Clinical assessment of the selected samples revealed of mouth ulcers, dysplasia and oral cavity lesions.
- Dysplasia is a condition which may transform into cancerous lesions which was observed in the selected 30 patients
- The clinical signs showed that all the selected subjects showed clinical signs associated with precancerous oral lesions namely mouth ulcer(25),Oral cavity lesions(30) and tooth discoloration(26),tooth decay(21) and pale pallor (26).All the selected subjects had oral lesions and dysplasia seen on the tongue or cheek.
- From the results it was found that except for fat all the other nutrient intake was deficit. Three, thirteen, thirty six, sixteen and forty seven percent deficit of energy, protein, calcium, iron and vitamin C respectively was recorded in the selected male samples.
- RBC and WBC count increased from 4.40±0.83 to 4.90±0.83 and WBC from 6.79-6.94 after the supplementation period. The marker enzymes like SGPT, SGOT and ALP decreased well from 38.70±1.54 to32.90±1.5432, 32.90±1.5430 to 30.00±1.58 and 52.94±0.71to47.30±0.68 respectively. The levels of antioxidant enzymes namely catalase(4.95±0.81 to 5.95±0.81)and SOD(1.22±0.12 to) increased in experimental groups. Statistically significant results were obtained.

CONCLUSION

Seaweeds have been consumed by population groups dating back to 100 centuries, but they have never found their rightful place in the daily diets of our population. The consumption of seaweed is sporadically seen near the coastal areas but with the rich and abundant supply of nutrients it has to be said that they are underexploited. Seaweed products are used commercially but as a natural food the goodness of seaweed have to be utilized by all of us.

The research points out the nutrient wealth these seaweed possess and with a substantial amount of protein, fat, carbohydrate and essential minerals iron, calcium, selenium, phosphorus, zinc, sodium and magnesium and essential vitamins C and A. The heavy metal composition below the detectable level wipes away any misgivings related to the source of seaweed. The toxicological evaluation of the seaweed brings forth the fact that they are safe for human consumption at 5g levels and can be consumed upto 10g everyday.

The antioxidant and antimicrobial studies clearly point out that seaweed can be used to enhance immunity and prevent oxidative stress among people. The inhibitory concentrations of the seaweed indicate the quality of food safety and the preservative action.

The therapeutic effect on anaemia whereby the moderate anaemic condition has been reversed to mild anaemic condition shows a promising result the seaweed could be an ideal food adjunct and be used to combat iron deficiency at large. So also the curative effect on precancerous lesions is significantly proved and hence can go a long way to be used as a potential functional food.

Seaweed has to be used as nature’s wealth and harnessed in the right way to promote future health.

Recommendations

- An analysis of aminoacids and nucleic acids present in the seaweeds
- Studies using seaweeds as an preservative
- Encapsulation studies can be carried out to make products out of seaweeds more palatable.

ANNEXURE II

OBJECTIVES

To select edible seaweeds, develop value added products and assess the therapeutic effect of the value added products.

The specific objectives were to:

- assess the microbial content, evaluate the toxicology and antioxidant activity and antimicrobial properties of the selected seaweed
- develop value added products with seaweeds and study the invitro iron bioavailability and antioxidant activity of the value added seaweed products
- study the impact of value added seaweed products among selected anaemic adolescent girls and adult males with precancerous oral lesions.

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR:
: Mrs. THAHIRA BANU.A

2. NAME AND ADDRESS OF THE INSTITUTION :

: Department of Home Science Thassim Beevi Abdul Kader College for women, Kilakarai, Ramanathapuram, TamilNadu, India

3. UGC APPROVAL NO. AND DATE : _F.NO. 32-458/2006(SR) dated 06.03.2007

4. DATE OF IMPLEMENTATION :1ST April 2007

5. TENURE OF THE PROJECT : 3years

6. TOTAL GRANT ALLOCATED : Rs 4,96,400.00

7. TOTAL GRANT RECEIVED : Rs 4,62,200.00

8. FINAL EXPENDITURE : Rs 5,05,713.00

9. TITLE OF THE PROJECT : *Nutrient and Therapeutic value of instant seaweed mixes from seaweeds collected from biospheres of Gulf of Mannar*

10. OBJECTIVES OF THE PROJECT : To select edible seaweeds, develop value added products and assess the therapeutic effect of the value added products.

The specific objectives were to:

- assess the microbial content, evaluate the toxicology and antioxidant activity and antimicrobial properties of the selected seaweed

- develop value added products with seaweeds and study the invitro iron bioavailability and antioxidant activity of the value added seaweed products
- study the impact of value added seaweed products among selected anaemic adolescent girls and adult males with precancerous oral lesions.

11. WHETHER OBJECTIVES WERE ACHIEVED: **YES**

12. ACHIEVEMENTS FROM THE PROJECT : **One Ph.D submitted for award of the degree to Avinashilingam Deemed University, Coimbatore. Three M.Sc dissertation submitted to Alagappa University, Karaikudi.**

13. SUMMARY OF THE FINDINGS :

The present study was carried out with the broad objective of finding the nutrient quality, antioxidant activity and the therapeutic use of green seaweeds. Seaweeds are the most fascinating aquatic organisms with tones of benefits for human race. Seaweeds namely Padina, Acanthophora, Ulva lactuca and Ulva recticulata was collected from Thonithurai, Rameswaram and subjected to proximate nutrient, minerals, heavy metals and phytonutrient analysis. The microbial count was also analyzed. These four seaweeds were subjected to acute and sub acute toxicity using animal model. Further the seaweeds that were found safe at 5000mg/kg body weight were selected for further investigations. The invitro antioxidant and antibacterial activity was tested. The seaweeds were then incorporated in seven products in two variations namely 2.5g and 5g. The products were subjected to consumer acceptability. The products viz chocolate and tea received the highest score among the seaweed incorporated products. The chocolate incorporated with ulva recticula and tea incorporated with ulva lactuca was selected for further investigations. These seaweeds products were subjected to iron bioavailability and invivo antioxidant activity studies. The result of this indicates that seaweed chocolate was suitable for supplementation to adolescent moderately anemic subjects and tea had high antioxidant activity, thus it was selected for supplementation to pre cancerous oral

cancers on adult male subjects. The result of the group was highly promising and these green seaweeds can be used for formulation of diet supplements and a potent functional food.

14. CONTRIBUTION TO THE SOCIETY

Seaweeds have been consumed by population groups dating back to 100 centuries, but they have never found their rightful place in the daily diets of our population. The consumption of seaweed is sporadically seen near the coastal areas but with the rich and abundant supply of nutrients it has to be said that they are underexploited. Seaweed products are used commercially but as a natural food the goodness of seaweed have to be utilized by all of us.

The research points out the nutrient wealth these seaweed possess and with a substantial amount of protein, fat, carbohydrate and essential minerals iron, calcium, selenium, phosphorus, zinc, sodium and magnesium and essential vitamins C and A. The heavy metal composition below the detectable level wipes away any misgivings related to the source of seaweed. The toxicological evaluation of the seaweed brings forth the fact that they are safe for human consumption at 5g levels and can be consumed upto 10g everyday.

The antioxidant and antimicrobial studies clearly point out that seaweed can be used to enhance immunity and prevent oxidative stress among people. The inhibitory concentrations of the seaweed indicate the quality of food safety and the preservative action.

The therapeutic effect on anaemia whereby the moderate anaemic condition has been reversed to mild anaemic condition shows a promising result the seaweed could be an ideal food adjunct and be used to combat iron deficiency at large. So also the curative

effect on precancerous lesions is significantly proved and hence can go a long way to be used as a potential functional food.

Seaweed has to be used as nature's wealth and harnessed in the right way to promote future health.

15. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT:**YES**

16. NO. OF PUBLICATIONS OUT OF THE PROJECT : **Refer Appendix - XIV**

PRINCIPAL INVESTIGATOR **PRINCIPAL**

CO-INVESTIGATOR **1.**

2.

Forwarded By

DEAN **REGISTRAR**