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Development of Low Cost Prawn Flavored Spicy Cracker with Prawn Waste and Drumstick (*Moringa oleifera*) Leaves

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***Abstract* — A recipe of spicy prawn cracker enriched with prawn head waste protein was developed from underutilized prawn head wastes and drumstick leaves which enriched with natural anti-oxidant. Studies were carried out to determine the effects of the prawn head waste powder and drumstick leaves powder on keeping quality and nutritional aspects of the product. Prawn head wastes were thoroughly washed and dried in hot air oven at 80°C for 4 hours and subjected to grind. Drumstick (*Moringa oleifera*) leaves were wilted for 5 days at the room temperature and finely ground. Primarily, preparation of cracker was arranged with several percentages of head waste powder and drumstick leaves powder with prescribe percentage of wheat flour, rice flour, vegetable oil, salt, dry yeast, pepper and water. Ingredients were mixed to make dough. The dough was kept flatted in a tray, cut into pieces of different shape by dies and put into the oven at 180ºC-200°C for 8-10 minutes. The best quality prawn crackers in terms of protein enrichment and sensory quality attributes were obtained through the recipe consisted with 2% (w/w) prawn head waste powder and 1% (w/w) drumstick leaves powder. Microbiological analysis demonstrated that the product is within the SLSI limits in room temperature up to 14 days. This research revealed that high quality protein fortified prawn crackers could be manufactured from underutilized prawn wastes. In conclusion, shelf life of the product can increase with the introduction of proper packaging method and consequently development procedure can be scale up.**

***Keywords* — Drumstick Leaves Powder, Prawn Cracker, Prawn Head Waste Powder.**

I. INTRODUCTION

Total production of prawns in Sri Lanka in 2011 was 25,830 metric tons. Prawn processing industries produce large quantities of wastes varying from 40-80% (w/w) depending upon species and process [1]. Solid waste comprises mainly head, tail, vein/viscera and shell. Prawn wastes are generally removed as garbage and dumped from the factory premises. This unauthorized dumping of wastes has always been paving the way of serious environmental pollution. In each factory, additional manpower is employed or spent money to dispose such valuable wastes from the factory premises. After trimming, a 40-50% (w/w) of the prawn is eventually wasted in the form of leg, appendages, head, shell and tail. These prawn wastes can be utilized as value-added human food, fish feed or chitin extraction.

There are many varieties of green leafy vegetables which are rich in natural source of iron and other essential micronutrients. However, they are discarded and are not used for human consumption [1]. Large numbers of reports on the nutritional qualities of moringa (*Moringa oleifera*) now exist in both scientific and the popular literature. It is commonly said that moringa (*Moringa oleifera*) leaves contain more β-carotene and vitamin A than carrots, more calcium than milk, more iron than spinach, more vitamin C than oranges, and more potassium than bananas and that the protein quality of moringa (*Moringa oleifera*) leaves rivals that of milk and eggs [3]. Snack foods are popular and very well exploited throughout the world. They are handy and light and usually eaten between regular meals [4]. Biscuits in cracker group are all used as long shelf-life bread substitutes and can be called. Crackers are low sugar fermented product which having dry flaky character made by wheat flour or rice flour crackers [5].Wheat is considered good source of protein, minerals, B-group vitamins and dietary fibers [6]. Rice is a principal cereal, a leading food crop of the world and a staple food of over approximately half of the world's population. Rice flour is significantly higher in calories and carbohydrate than wheat flour and fewer in fiber.

Prawn cracker is a deep fried or baked snack food which is well known among Asian countries especially among East and South East Asian people. The technology for producing prawn cracker is very simple and it requires less complex machinery [7]. No attempt has so far taken to formulate and develop edible products or other value-added products from prawn waste in Sri Lanka. Therefore, objective of this research was to formulate and develop protein and mineral enriched prawn crackers from underutilized prawn waste and thereby to develop the low cost and environment friendly techniques to utilize the waste of prawn processing industries and to manufacture food products for human consumption.

II. MATERIALS AND METHODOLOGY

A. Preparation of Prawn Head Waste Powder

Prawn head wastes were thoroughly washed by potable running water and then prawn head wastes were washed with 5% (w/v) diluted sodium chloride solution followed by washing with potable running water to remove excess salt. Prawn head waste was dried in a hot air oven at 80ºC for 4 hours and finely ground. Ground prawn head wastes were screened by fine mesh sieve and obtained powder was packed in glass bottles and stored in a refrigerator at 4ºC.

B. Preparation of Drumstick Leaves Powder

Fresh drumstick leaves were washed by potable running water and wilted for 5 days in room temperature. Wilted drumstick leaves were finely ground and powder was

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drumstick leaves were finely ground and powder was packed in air tight polythene bag and stored in a refrigerator at 4ºC.

C. Product Preparation

Primarily, study was designed to find out the optimum time temperature combination of oven drying of prawn head waste, best cracker recipe and incorporation level of prawn head waste powder and the drumstick leaves powder in terms of sensory attributes in cracker. Subsequently, finely ground prawn head waste powder, finely ground drumstick leaves powder, wheat flour, rice flour, salt, dry yeast, vegetable oil, pepper and water were used to prepare the product. Initially preparations were arranged with several percentages of prawn head waste powder with different oven dried treatments of head waste to finalize the recipe and the optimum heat treatment for head waste powder preparation and several percentages of drumstick leaves powder to decide the percentage of drumstick leaves powder incorporation in a cracker and sensory results were used to finalize the final recipe consists with 2% (w/w) prawn head waste powder after 4 hours oven drying, 1% (w/w) drumstick leaves powder, 50% (w/w) wheat flour and 50% (w/w) rice flour. During cracker preparation, above-mentioned ingredients were adequately mixed adding water and dough was formed. Formed dough was kept 18 hours in 4ºC refrigerator and pressed in a flat tray and cut by different dies for different shaped crackers and baked at 200°C for 10 minutes and cooled for 5 minutes in a room temperature.

D. Proximate Analysis

Moisture of the product was analyzed using 2-5g of homogenized sample at 100-105ºC in a drying oven. Crude fat analysis was conducted according to standard Soxhlet method. Crude protein was carried out with Kjeldhal method with some modifications and Ash and Crude fiber value of the product was calculated [8].

E. Keeping Quality Analysis

Microbiological and pH analysis were used to measure the keeping quality of the final product. Total Plate Count Analysis was carried out with pour plate method using Plate Count Agar with some modifications [9]. *Salmonella* analysis was conceded with Direct Enrichment method. Homogenate of sample at ratio of 1: 9 samples to distilled water, diluted through a series of tubes. Approximately 1mL of diluents of each tube with 9mL of *Salmonella* enrichment broth (Hi-MEDIA, India) incubated at 37°C for 48±2h. A loopful of each broth Sub cultured to Xylose-Lysine-Deoxycholate agar media (Hi-MEDIA, India). Plates were incubated at 37°C for 20–24h. The plates were examined for typical colonies. *Coliform* analysis was carried out with pour plate method with some modifications [9]. Homogenate samples were poured into petri dishes and procedure was repeated with each dilution prepared. 15mL of molten Violet Red Bile Agar (Hi-MEDIA, India) was added to each plate, cooled to 44–47°C and mixed carefully and allowed to set. Plates were incubated at 37°C for 24±2h and observations were recorded. To determine the keeping quality of the prawn cracker, pH of the homogenate samples was measured using calibrated digital pH meter with time duration of 7, 14 and 21, up to 28 days.

D. Sensory Analysis

Odorless, disposable paper plates and sample was coded separately with a three-digit number and served for the sensory evaluation. Panelists were instructed to refresh their palate by rinsing with noncarbonated water before tasting subsequent samples. Thirty untrained panelists (Age group 21-25 years / male & female) assessed the appearance, texture, color, mouth feel and overall acceptability scores of the samples using a 5-point hedonic scale.

III. Results and Discussion

A. Proximate Composition Analysis

Proximate Composition of the Prawn Flavored Spicy Cracker with Prawn Waste and Drumstick (*Moringa oleifera*) Leaves consist with 13.06 % of crude protein content. Also found almost similar value of protein composition in prawn cracker. Protein content of prawn head was quite high compared to the reported ranges of 8.9–23.2% in whole prawn [7]. However fat content was lower than 5%, therefore it was categorized as low fat snack. Crude fiber of the product was 2.50%. According to [3] shadow dried drumstick leaves having 1.21% crude fiber amounts. Rest of other crude fiber came from the added wheat flour to the cracker biscuit.

Table 1: Proximate of spicy prawn flavored drumstick leaves cracker (dry basis).

Physiochemical property	Amount (%)
Total carbohydrate	62.34
Crude protein	13.06 ± 0.66
Crude fat	15.80 ± 0.16
Moisture	3.90 ± 0.00
Ash	2.40 ± 0.07
Crude fiber	2.50 ± 0.06

**All values are given as percentage with their standard deviations.*

Results were well demonstrated that, proximate composition of the developed snack satisfies the recommended levels of nutrition intakes. Furthermore, fluctuations of the values in terms with the recommended values give additional benefits to the consumers of the products compared to same type of products in the market with different origins.

B. Keeping Quality of the Product

According to U.S. Food & Drug Administration Center for Food Safety and Applied Nutrition Foodborne Pathogenic Microorganisms and Natural Toxins Handbook the prawns' pH value should be in the range of 6.8–7.0 and cracker biscuit should be in 7.1–7.3. Changes in pH value of products measures as a measurement of physicho chemical changes occurred in foods while storage room temperature and measurements were taken into consideration within 7 days' interval for 1 month storing period.

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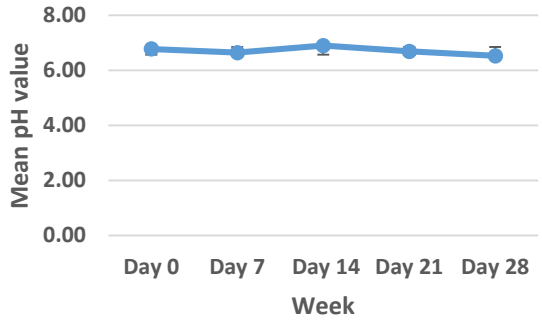

Fig. 1. pH change of the Prawn Flavored Spicy Cracker with the storage time

pH of the product not significantly vary within the measured period. It was around below pH 7. Initial pH value is 6.77 ± 0.05 and day 28pH value is 6.52 ± 0.02. As in fig1. Product is relevance with the standard. Thus pH value of the product is not significantly affects to changing properties of the biscuits, it reveals that product is acceptable for consume during the measured period. Moisture of the product is 3.90%. It is also similar in prawn chilly crackers done by 3.80%. Moisture and water activity of the product determine greatly the keeping quality of the foods. These values were minimal and may not have adverse effect on the quality attributes of the product [10].

Within the one-month time duration the *Coliform* present in the food product was zero. According to the [7] *Coliform* bacteria are heat sensitive microorganism they could be destroyed during the 180°C–200ºC baking process. Moreover, *Salmonella* was not detected with the storage period However; accordingly, SLS 251 2010 microbial contents of all biscuit samples were below the maximum acceptable levels [11]. Maximum total plate count of biscuit is 5×10^4cfu/g, maximum yeast and mould count is 5×10^3, and coliform (MPN) is 5×10^3cfu/g. It revealed the cracker is in the acceptable level under the ready to eat product category. However, shelf life of the product can be increased with modified packaging material. Further, polypropylene bag with ultraviolet treatment may help to extended shelf life of the product.

IV. Conclusion

The study has shown that the crackers produced from prawn head waste powder and drumstick leaves powder were generally acceptable to the consumers, although perceptible differences were noticed in the sensory properties of some combinations. The panelists preferred formulations composed of fairly lower proportion of 2% (w/w) prawn head waste powder and 1% (w/w) drumstick leaves powder. Product was comprised with specific nutritional requirements such as a high crude protein, crude fiber and lower fat value. Finally, application of prawn waste in cracker production would create another avenue for profitable and diverse usage of the commodity

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Author's Profile

Dr. E.D.N.S. Abeyrathne, corresponding author and the supervisor of this study is an eminent academia and a researcher who has completed Bachelor of Science in Agriculture in University of Peradeniya, Master in Science in Dairy and Meat Product Technology in Post Graduate Institute of Agriculture, University of Peradeniya, Sri Lanka and subsequently his PhD in Biomodulation in Seoul National University, Seoul, South Korea (2010- 2013). His major field of study includes isolation and separation of bio active compounds from poultry eggs and fresh water fish. Currently he has been serving as a Senior Lecturer attached to the Department of Animal Science, Uva Wellassa University of Sri Lanka, Badulla since 2007. Further he has contributed his valuable service as a Research Assistant, Protein chemistry Laboratory, Seoul National University, Seoul, Korea (09-2010to08-2013) and Research Assistant, Poultry Meat Laboratory, Iowa state University, Ames, IA, USA (11-2012 to 02-2013).

Meantime he has published many scientific papers in various reputed journals and conferences both locally and internationally. Few important publications are as follows. Abeyrathne E.D.N.S., Lee, H.Y., Jo, C., Suh, J.W. and Ahn, D.U. Enzymatic hydrolysis of ovomucin and the functional and structural characteristics of peptides in the hydrolysates. Food Chemistry. 2016, 192: 107-113. Ishani A.H.M.E. Herath, Jayasinghe J.M. Priyanath, Dong U Ahn, E.D. Nalaka S. Abeyrathne.. Use of lysozyme from chicken egg white as a nitrite replacer in an Italian-type chicken sausage. Functional Food in Health and Diseases. 2015, 5(9): 319-329. Abeyrathne E.D.N.S., Lee, H.Y. Jo, C., Suh, J. W. and Ahn, D.U. Enzymatic hydrolysis of ovomucoid and the functional properties of its hydrolysates. 2015,94 (9) :2880-2287. His current research interests basically focus on development of functional food to control type II diabetics and obesity, development of value added products from poultry eggs and fresh water fish, identifying natural antioxidants from livestock products, identifying hazard points in food processing and minimizing the hazards with cost effective methods. Moreover, Dr. Abeyrathne is

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a life time member in Sri Lanka Association of Animal Production (SLAAP) and Sri Lanka Institute of Food Science and Technology (IFST-SL). Further he has been awarded with several titles including Young Scientist research award in WCU Biomodulation, 2013, Third place awarded in the poster retreat of WCU Biomodulation Major 2011 under PhD category, 4th International Biomodulation Symposium, Seoul national University, second place awarded in the poster retreat of WCU Biomodulation Major 2012 under PhD category in WCU Biomodulation Major, Department of Agricultural. Additionally, Dr. Abeyrathne's outstanding findings in the doctoral studies have been rewarded with patents and he has bagged two patents in Separation of ovotransferrin from chicken egg white using environmental friendly techniques (Patent number:10-2012-0143230) and sequential separation of lysozyme and ovalbumin from chicken egg white (Patent number: 10-2013-0003215).

Ms. A.L.Y.H. Aruppala contributed in preparation, writing, formatting of this paper and further she has completed Bachelor of Animal Science (BASc) (2011-2015), Department of Animal Science, Uva Wellassa University of Sri Lanka, Badulla and subsequently reading her Master in Science in Food Science and Technology in Post Graduate Institute of Agriculture, University of Peradeniya. Her major area of study is animal science with special emphasis on animal products, nutrition and food technology. She initiated her career as a research student at Veterinary Research Institute, Gannoruwa, Sri Lanka. Further she has served as an assistant lecturer attached to the same department where she graduated. Meantime she published several research publications locally.

Few recently published scientific findings are as follows.

A.L.Y.H Aruppala, U.L.P. Mangalika, A.M.N.L. Abesinghe, R.R.M.K.K Wijesundara, M.K. Ranasinghe, "Study on Composition and Adulterants of Cow Milk in Kandy District", Proceeding of 6th Research Symposium 2016, Uva Wellassa University of Sri Lanka, pg-30, A.L.Y.H Aruppala, R.P.N.P Rajapakse and E.D.N.S. Abeyrathne, "Determining the Functional Properties of hydrolyzed Ovalbumin Incorporated Fish cake produced from Catla (Catla catla)", Proceeding of International Research Symposium of Uva Wellassa University 2017. pg- 175, A.M.P.M Arampola, A.L.Y.H Aruppala and E.D.N.S. Abeyrathne, "Comparison of different enzyme inactivation methods and the functional properties of the peptides derived from ovomucin", Proceeding of International Research Symposium of Uva Wellassa University 2017. pg-182, W.A.K.D. Savindi, A.L.Y.H Aruppala and E.D.N.S. Abeyrathne, "Comparison of Different Enzymatic Inactivation Methods for Ovalbumin and the Functional Properties of Peptides Derived", Proceeding of International Research Symposium of Uva Wellassa University 2017. pg-171, K. Wathsani, A.L.Y.H Aruppala and E.D.N.S. Abeyrathne," Determination of the Functional properties of peptide derived from Ovalbumin Incorporated Breakfast cereal" Proceeding of International Research Symposium of Uva Wellassa University 2017. pg- 180. Her current researches basically focus on functional properties of foods.

Mr. L. K. Martyn contributed in investigation, sample preparation and analyzing for the study and writing the paper as a part of his undergraduate research study. He completed his (BSc) in Aquatic Resources Technology, Department of Animal Science, Uva Wellassa University of Sri Lanka. (2011-2015). Moreover Mr. Martyn has shown strong interest in researching on aquatic food product development with special emphasis on value addition to the underutilized aquatic local resources.

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