Proximate Analysis and Utilization of Research Generated Products from Fish and Indian Mango

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Abstract –*CHED and DOST support the conduct of RDE aimed to generate, adopt, and transfer, improve productivity and livelihood, and alleviating poverty in the countryside. (www.ched.gov.ph). In response to this program, Pangasinan State University Food Innovation Center aimed to develop technologies namely; a. standardization, analysis and packaging fermented fish-rice mixture; b. development of Indian Mango products and transfer these developed technologies to interested cooperators in the community in order to generate employment and raise revenue of the town. The food technology of buro like fermentation process and food preservation of indian mango were integrated in the 1) high school science investigatory projects, college level Biology, Chemistry and Entrepreneurship subjects. The integration of the technologies made the curriculum rich and became an outcomes based curriculum. Students produced and developed products out of research. The food technologies were also transferred and adopted by the barangay which helped the barangay generate a small scale industry at home and cooperative. Economic growth in the barangay grew due to generation of employment.*

Keywords: *generated products, curriculum integration, sustainability, economic growth*

INTRODUCTION

National Higher Education Research Agenda 2 (NHERA- 2- 2009-2018) supports the higher education sector's goals to develop high level manpower and globally competitive professionals and to generate knowledge and technology for enhancing productivity and quality of life in order to reduce poverty and ensure sustainable development in the country (CMO No.42 series of 2010). CHED Strategic Plan for 2011-2016 includes aligning of HEI programs with national development goals, and one way to achieve this is a relevant and responsive research, development and extension (RDE). Under this program, CHED and DOST support the conduct of RDE aimed to generating, adapting and transferring improving productivity and livelihood, and alleviating poverty in the countryside [1].

The academe is a major agent of economic growth. It is both a Research and Development Laboratory and a mechanism through which the nation builds its human capital to enable it to actively participate in the global economy [2]. In response to the above program, Pangasinan State University (PSU) College of Teacher Education, a Center of Excellence aimed 1) to develop technologies namely: a. Standardization, analysis, and packaging of fermented fish-rice mixture (burong dalag) and b. Development of Indian Mango Products and 3) Transfer these developed technologies to interested cooperators in the community in order to generate employment and raise revenue of the town.

Development of food technologies is a solution for poverty and post-harvest problems. Since safe food is essential both the academe like PSU and the food industries continuously develop products which translate to boost health, increase revenue, generate employment and consequently reduces harvest loss by microorganisms, chemical and enzymatic reactions during the peak of harvesting period [3].

Fresh water fish is abundant in Bayambang thus, fermented fish like buro is a native product of Bayambang, Pangasinan, Philippines. It has already been part of Bayambang's unique culture. Despite the delicious taste of buro, there has been no serious study about their nutritional value, processing, fungal/bacterial content, packaging media, shelf-life, standardization and marketability of the product. The propagation and promotion of buro for export has

been continuing in nominal amount due to its repellent smell and substandard quality. The study had aimed to establish standard formula for everyone to eat safe, sweet smelling and palatable burong dalag.

On the other hand, Indian Mango development in Region 1 among growers experience the problems of abundance, low utilization and high percentage of rotting due to anthracnose when ripe during the peak season. Indian Mango variety is the least consumed particularly when ripe. The Indian Mangoes when ripe taste sweet, stale, and less sour. The unlikable taste and presence of fibers of ripened Indian mangoes caused the mangoes to be cheap when ripe. Hence, there is a need to process the ripe fruit into pastillas, jam, juice while the green ones can be processed into chutney. Thus processing of both fish and indian mango had been the primary aim of this project.

METHODS

A. Development of Buro Technology

The flow of the project on technology generation could be summarized as follows: (1) Initialization, (2) Cleaning, eviscerating and steaking the fish, (3) Test for type of salt, (4) Test for salt proportion, (5) Fermentation process, (6) Standardization of cooked buro, and (7) Laboratory analyses of cooked buro. In addition to the usual practice of cleaning the fish, beheading the dalag and freezing before salting are the new steps in cleaning. Hygienic cleaning and handling of fish helps minimize growth of pathogenic bacteria and molds from the very start. Hygienic cleaning and freezing eliminates further growth of pathogens. The removed head and other internal organs were sold to minimize waste while scales were left buried in a pit. Salting is one of the critical points of making buro. The new formula used 24% rock salt to ferment dalag in 18-20 days. Controlled growth of harmful bacteria and fungus was established at several critical points. Analyses of bacterial growth at the critical points helped eliminate harmful bacteria that may further cause foul smell and early spoilage of buro. The process of reducing the salt content implies early harvesting of buro (after 18 days) and contributes to its lesser risk factor of eating too much salt.

After fermentation, cooking the buro or subjecting the product to a required heat also helped kill pathogenic bacteria. The product requires pasteurization at an initial heat of 37^{o}C (heat filled) [4] and proximate analysis. Simple recipe such as buro sautéed in corn oil and garlic with no preservative added packed in 8 oz. glass jar with appealing label and appearance was tested in market. The generated technology was techno transferred to Nanay Doray (Shellflex Food Products) of Bongato East, Bayambang, Pangasinan.

B. Development of Indian Mango Products

The concept of pickling was applied in chutney production [5], jam making, vinegar production, pastillas and juice making were applied to the developed products. However, Vitamin C enrichment were applied to jwereuice, jam and pastillas. Safety food techniques such heat penetration were tried to preserve chutney and jam. Several acid tests on different stages were applied to monitor the pH in both chutney and juice. Amount of suspended solids (BRIX) was determined at the start of the procedure and after the finished product in order to adjust the amount of sugar in the product. At the end of the final (best) formula and processing procedure of each product the chutney, pastillas, jam and juice were tested for microbial load, chemical properties and sensory testing were conducted. Microbial load test is a standard procedure for food safety technology. Package compatibility, acceptability and proximate analysis were also done as standard procedure for production. These processes are confirmatory tests to pass the safety standards of food production. The indian mango generated technology was techno transferred to LGU San Carlos City Pangasinan Cooperative [6] and Sn Esteban, Ilocos Sur.

C. Utilization of the Research generated products

The generated products' technologies were transferred to interested barangays and individuals. After the techno-demo, transfer of technology and market try out, monitoring of the products the technologies were tried for curriculum integration in several subjects. Fish and fruits fermentation, candy making, fungus and bacterial screening and simple nutrient detection were applied in high school science curriculum and college level subjects like Biology, Chemistry, Technology Livelihood and Education, Marketing.

RESULTS AND DISCUSSION

A. Buro Technology

The results showed that at 24% salt buro fermentation takes place as early as 18 days to 21 days. Beyond 30 days buro smells very sour, texture is soft, easy to disintegrate and watery.

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The basic recipe of buro sautéed in garlic was considered the basic recipe to start with other recipes and the best recipe according to sensory test with an average mean of 7.2 using 9 point Hedonic scale. The product has a pH below 4.2 and is acidic. Its low acid level indicates less survival of pathogenic bacteria. Cut out test results shows that the product is acceptable. Heat penetration test at processing temperature of 100ºC with reference or target organism *Clostridium pasteurainum.* Failure to heat processed fish at higher temperature may allow heat-resistant spores of dangerous bacteria *Clostridium* to survive, germinate, and grow [7]. The heat at 44 minutes was the requirement measured during penetration test, to disallow harmful bacteria to grow. Table 1 shows that the suggested heat penetration for fermented fish for safe consumption. Buro uses a cut off of 44 minutes at 100 degrees Centigrade.

Table 1. Heat Penetration Test

Initial Temperature	Minimum processing time at 212ºF (100ºC) minutes
80º F (26.7ºC)	47.0
100º F (37.8ºC)	44.0
120º F (48.9ºC)	41.0
140º F (60ºC)	37.0
160º F (71.1ºC)	31.0

Based on the nutrient (proximate) analysis as seen in table 2, *ginisang burong dalag* is beneficially nutritious.

The establishment of buro processing unit and its adoption by the cooperator at Bongato East Bayambang, Pangasinan shows that the technology is adoptable due to its simple preparation and nutritional content. The pilot test on technical management, organization and marketability of the technology in PSU and Bongato East also found that there is high desirability to use the procedure. The project was found to be financially viable. Economic feasibility/profitability analysis also shows that the product is feasible. It has 48.36% net income for raw and 36.26% for cooked.

Table 2. Proximate Analysis

Nutrient and Unit	Content
Moisture, % w/w	46.07
Ash, % w/w	3.34
Protein (N x 6.25), % w/w	6.43
Fat, % w/w (acid hydrolysis)	15.45
Total carbohydrate, % w/w	28.71
Food energy, k/cal/100g	280.00
Total sugar, % w/w	5.40
Calcium mg/kg	1010.00
Sodium mg/kg	10,700
Iron mg/kg	4.67

B. Development of Indian Mango Products

The best formula of the developed indian mango products were described according to their nutritional values analyzed by DOST-Region 1. Table 2 shows the nutrients of the four developed products from indian mango. The indian mango jam, chutney, and pastillas are rich in carbohydrates (31g/60 gr), and dietary fiber (25gr/60gr). All products contain crude protein except for juice. Pastillas had the highest crude protein due to its added milk products. Jam, pastillas and juice contain crude fat except for chutney. Chutney has the highest traces of sodium(316mg/100g) followed by pastillas (100mg/100gr) since salt was used in the formula however, no sodium was detected in jam and juice. The four products contain potassium and iron. Pastillas contains the highest potassium content among all the products.

Table 3. Development of Indian Mango Products

Nutrients	Jam (350g/bottle =6 serving size of Approx. 60 gr	Chutney (60g/serving size)	Pastillas (50g/serving size)	Juice diluted (250 mL per serving size)
Total carbohydrates	31g/60 g	31g/100g	31g/50g	8g/250g
Dietary fiber	25g/60g	25g/100g	25g/50g	25g/250g
Ash	12.34g/100g	11.18g/100g	19.50g/100g	1.60g/100g
Moisture content	35.95g/100g	53.73g/100g	19.84g/100g	84.74g/100g
Crude protein	0.20g/100g	0.60g/100g	5.53g/100g	0
Crude fat	0.09g/100g	0.00	0.13g/100g	0.12g/100g
Sodium	Not detected	316mg/100g	100mg/100g	Not detected
Potassium	23.00mg/100g	44 mg/100g	1926mg/100g	4mg/100g
Iron	0.51mg/100g	0.49mg/100g	0.42mg/100g	0.22mg/100g

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The Vitamin C detection in diluted mango juice and concentrated mango juice was taken because high dilution with water may deplete the Vitamin C content of the fruit. (AOAC INTERNATIONAL, Gaitthersburg, MD, USA, Official Method, 967.212). Vitamin C of diluted mango juice is equal to 1.9mg/100g while Vitamin C of mango juice concentrate is 23.4 mg/100g. The estimated amount of sugar for mango puree proportion must reach 20^{o} Brix [7].

All the developed products have a yellow color that resembles the ripe indian mango except for jam which is slightly darker yellow. Jam and juice both taste sour sweet, pastillas is sweet and chutney is more of sour taste since it contains vinegar as one of its ingredients. The products have mango aroma. Jam is characterized with spreadable consistency, pastillas is smooth and melts in the mouth, chutney and juice have medium syrup. Lastly, all the products have high acceptability [8].

In terms of microbial load, jam, chutney, pastillas and juice passed the acceptable microbial load which is less than 500 CFU/g or MPN/g (Codex). There were no detected contaminations due to low or within acceptable limits of microbial load during the packaging stage. The processing stages of jam, chutney, pastillas and juice followed the standard procedure of proper food handling, safe and free from contamination during handling stage.

The developed indian mango products have high potential market value as shown in the computation of the return of investment during the pilot test commercialization. Adoption of the technology was pilot tested during the techno-demo (sponsored by DTI & DOST) in San Carlos City, Pangasinan. Through its cooperative, jam, chutney, pastillas and juice were adopted as their OTOP products.

D. Utilization of the technologies

The important contribution of buro technology to the consumers is the food safety and good quality of buro during its utilization. The improved technology ensures food safety with nutritious elements or compounds. Buro technology was adopted by Shellflex Food Products and other interested individuals. The improved buro technology produced delicious and nutritious product, increased production, increased market sales, generated employment, and contributed to increased revenue of the town.

On the other hand, indian mango technology developed four products, jam, pastillas, chutney and juice. The four technologies were adopted by LGU Sn Carlos City Cooperative, Cervantes and Sn Esteban, Ilocos Sur. The generated technology resulted to nutritious, food safety products which are highly marketable. These technologies also improved the post-harvest of indian mango and increased its market value during its peak season. The cheap indian mango during its peak season have picked up its price. LGU Sn Carlos City Cooperative adapted the indian mango technology which generated employment and contributed to increased sales. Several techno demo and product exhibit were attended to display not only the product but to disseminate the technologies.

Both buro and indian mango technologies were integrated in the high school science curriculum and college level Technology and Livelihood Education and Marketing. Fungus and bacterial screening for food were integrated in Biology while simple nutrient analysis was integrated in Food Chemistry. In marketing students experience selling, promoting and advertising the products.

CONCLUSION AND RECOMMENDATION

The standardized ginisang burong dalag packed in 8 oz. glass jar has shelf life of 365 days at ambient temperature, is highly acceptable food product, with potential for export. Its production is financially profitable and viable. The generated buro technology is easily replicable, adoptable and sustainable. Pilot production in Bongato East created employment, which helped alleviate the socio-economic status of the barangay folks. The technology contributed also to entrepreneurial development of students in PSU Bayambang. This study opens an avenue to new researches for alternative fish for buro (aside from dalag). It also leads to complex engineering design for equipment in the production of other foodstuffs and by products of buro.

The developed indian mango jam, chutney, pastillas and juice are delicious and nutritious food products. They are good sources of energy, dietary fiber and minerals that can remedy malnutrition. The products have good physical characteristics for manufacturing and commercialization. The products' processing is simple, easily replicated, raw materials, equipment and instruments are accessible and feasible for adoption for big and small industry.

New package compatibility test for aluminium pouch for the juice should be conducted to reduce the price and increase its return of investment. Production for Indian mango products can be best during

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December to middle of July of the following year. During the peak months of February to May increased production can be done to cover for the lull production during low supply of Indian mangoes.

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