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Are Locally Made Sanitary Products Consumer-Cost Friendly?

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The COVID-19 pandemic has not only resulted in a staggering number of casualties but has also led to a significant depletion in the availability of crucial sanitary supplies worldwide. In the province of Northern Samar, this shortage was keenly felt, with essential items like face masks, rubbing alcohol, and soap becoming scarce within the first week of the gradual closure of businesses. Consequently, individuals with limited financial means encountered immense challenges in obtaining these vital sanitary products to safeguard themselves against the deadly virus. As the sole public institution of higher education in Northern Samar, the University of Eastern Philippines (UEP) took proactive measures to address the dwindling supply of sanitary goods. Leveraging its research and development unit, UEP embarked on initiatives to bolster local communities' access to essential items. Notably, these efforts included the production of antibacterial bar soap derived from *Salacia korthalsiana* Miq. (Polipog) and bioethanol extract sourced from *Nypa fruticans* (Nipa)

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palm. These innovative products developed by UEP were subsequently distributed to underserved communities across Northern Samar. Through a comprehensive cost-benefit analysis, it was established that UEP's offerings were significantly more affordable compared to those available in commercial outlets. This underscores the potential for UEP, with adequate financial backing from both internal and external sources, to continue developing cost-effective sanitary solutions tailored to economically disadvantaged communities' needs.

Keywords: Accessibility efforts; cost-effectiveness; local resilience; sustainable development; sanitary products; antibacterial bar soap; immense challenges.

1. INTRODUCTION

Amidst the backdrop of the COVID-19 pandemic, higher education institutions have emerged as crucial players in the fight against the spread of the virus. These institutions, traditionally revered as centers of learning and innovation, have swiftly pivoted their focus and resources towards addressing the multifaceted challenges posed by the pandemic. With their vast reservoirs of knowledge, expertise, and infrastructure, universities have undertaken a myriad of initiatives aimed at mitigating the impact of the virus on communities at large [1,2].

One prominent avenue through which higher education institutions have contributed to combating COVID-19 is through research and development endeavors. Across diverse academic disciplines, researchers have been mobilized to investigate various aspects of the virus, ranging from its molecular structure to its epidemiological dynamics. Through collaborative efforts involving faculty, students, and external partners, universities have played an instrumental role in advancing our understanding of COVID-19, thereby informing evidence-based strategies for containment and treatment [3,4].

Moreover, higher education institutions have leveraged their academic prowess to spearhead public health campaigns and community outreach initiatives. Through the dissemination of accurate information, educational resources, and preventive measures, universities have endeavored to empower individuals with the knowledge necessary to safeguard their health and that of their communities. By harnessing their institutional networks and communication channels, universities have effectively served as conduits for disseminating critical health-related information to diverse demographics, including vulnerable populations [5-8].

As the global community continues to grapple with the enduring challenges posed by the COVID-19 pandemic, the indispensable role of higher education institutions in combatting the virus cannot be overstated. Through their steadfast commitment to knowledge generation, community engagement, and innovation, universities have emerged as linchpins in the collective effort to safeguard public health and build resilience against future pandemics. Moving forward, it is imperative that stakeholders across academia, government, and civil society continue to collaborate synergistically to harness the full potential of higher education in confronting present and future health crises.

Since the onset of the COVID-19 pandemic, UEP has been engaged in the dissemination of various products, including disinfectants, laboratory-synthesized ethyl alcohol, and liquid soap derived from the *Polipog plant*, among its internal workforce. These products have been distributed not only to provincial and local governmental entities but also to stakeholders and the broader UEP community. Stringent manufacturing and sanitation protocols were rigorously adhered to throughout the duration of this initiative. Before being made available for distribution and use, all products underwent comprehensive physicochemical assessments. The local government was enlisted to aid in the distribution process. It is important to note that this endeavor is not confined to the current pandemic; rather, it is envisioned as a sustainable venture for the University, poised to generate income once normalcy is restored, without incurring additional expenses. Furthermore, it is intended to serve as an educational platform for students. The availability of raw materials such as *Nypa fruticans* (Nipa) and *Salacia korthalsiana* Miq. (Polipog) plant samples remains abundant, as these resources are underutilized in the province.

Nypa, a well-known indigenous resource in Northern Samar, primarily utilized for roofing purposes, has largely remained unexplored in terms of its fruit's potential [9]. Research has shown that the fruit of the nipa palm harbors starch, which can be leveraged for the biosynthesis of zinc oxide nanoparticles (ZnONps). These nanoparticles, when reduced to nano-scale, exhibit notable antibacterial properties, effectively targeting both gram-negative and gram-positive bacteria [10,11]. Despite the availability of other metal oxides in the market, ZnONps with nipa starch demonstrate distinctive characteristics and offer relative ease of synthesis [12-14].

The inhabitants of the various island towns of Northern Samar, totaling approximately 700,000 individuals, heavily rely on palm species like *Nypa fruticans* for sustenance. Despite the prevalence of Nypa, its economic utility remains largely untapped, with its fruit currently serving no commercial purpose. *Nypa fruticans* is unique in its adaptation to mangrove biomes, being the sole palm species suited to such environments. It stands as the sole member of the genus Nypa and the subfamily Nypoideae, rendering it a monotypic taxon [15].

The fermentation of *Nypa fruticans* using yeast for a minimum of 14 days facilitates the extraction of bioethanol, subsequently subjected to rigorous quality assessment. Technical-grade ethyl alcohol and bioethanol derived from Nypa fruticans serve as the primary raw materials for laboratory-synthesized ethyl alcohol production. The distribution of these materials varies, with technical-grade ethanol-based alcohol allocated to hospitals within the province to alleviate shortages of rubbing alcohol, while Nypa fruticans-derived ethanol is distributed to other designated beneficiaries. Laboratory-synthesized ethyl alcohol constitutes a blend of ethyl alcohol (either technical-grade or bioethanol), hydrogen peroxide, glycerol, and distilled water [12,13].

Salacia korthalsiana Miq., commonly known as Polipog, is a traditional medicinal plant utilized for its anti-inflammatory, antiseptic, antimicrobial, and other therapeutic properties [16-18]. This climbing shrub, characterized by woody stems twining into surrounding vegetation, can reach lengths of up to 18 meters. Occasionally, it produces erect branches, adopting a more shrub-like or tree-like form, with heights of up to 10 meters [19]. Harvested from the wild for both culinary and medicinal purposes, extracts from *Salacia korthalsiana* Miq. are employed in the production of both liquid and bar soap [12,13]. Additionally, a team of technology-livelihood students oversaw the production of face masks, with supplementary protective coatings incorporated to enhance bacterial resistance on the textile surface. By scrutinizing the cost-effectiveness of locally sourced plant-derived sanitary products, our study aims to shed light on their affordability and market competitiveness. In doing so, we seek to provide valuable insights into consumer preferences, purchasing behaviors, and the broader economic implications of promoting locally manufactured alternatives.

2. METHODOLOGY

The methodology employed in this research encompasses a descriptive-experimental research design aimed at conducting a comprehensive cost-benefit analysis of locally made sanitary products compared to commercially available alternatives. The study focuses on assessing the economic viability of these products, particularly through a cost analysis, while also exploring the feasibility of their production processes. The researchers conducted a meticulous cost analysis of the sanitary items produced locally in comparison to commercially available ones. This analysis involved determining the costs associated with sourcing raw materials, production processes, packaging, and distribution. By quantifying these expenses, the researchers sought to evaluate the economic feasibility of manufacturing sanitary products using indigenous plant samples.

Throughout the production processes of both ethyl alcohol and soap, meticulous attention was paid to ensuring adherence to standard procedures and maintaining quality control measures. This included maintaining proper laboratory and hygiene practices, precise measurement of ingredients, and adherence to recommended curing periods for the soap.

It also involved a systematic approach to conducting a cost-benefit analysis of locally made sanitary products, encompassing detailed cost assessments and rigorous production processes. Through these efforts, the researchers aimed to provide valuable insights into the economic viability and feasibility of utilizing indigenous plant samples for the production of essential sanitary items.

3. RESULTS AND DISCUSSION

The figures below explained the cost analysis of sanitary items developed by the university. In

Fig. 1, the cost analysis of the antimicrobial bar soap (Php9.00/piece) is much lesser than the commercially available soap which cost about Php15.00. This tells us that the developed sanitary item is customer friendly and can be acquired by less-in-life individuals. Fig. 2 also provides an idea of how much cheaper our developed lab-made ethyl alcohol is. Based on the cost analysis, some 500mL of the lab-made ethyl alcohol only cost Php40.00 which is cheaper than commercially available ethyl alcohol of 500mL which cost Php95.00. Fig. 3 shows the cost analysis of the antibacterial facemask which only costs Php9.00 per piece. The antibacterial facemask contains biocomposite solutions that can inhibit the growth of pathogenic microorganisms. The commercially available reusable facemask cost Php20.00/piece.

The figures explain that the sanitary items developed by UEP could be a substitute for the commercially available items. This only proves that local resources, if used properly, could generate income for the farmers and could offer cheaper products.

ANTIMICROBIAL BAR SOAP WITH POLIPOG EXTRACT

MATERIALS	PRICE PER BATCH PRODUCTION
NaOH	Php60.00
Canola Oil	325.00
Distilled Water	19.00
Castor Oil	150.00
Salacia korthalsiana Miq. (Polipog) Extract	150.00
CDEA	27.00
NaCl	20.00
Molder	250.00
TOTAL	**Php1001.00**

LABOR	PER HOUR BASIS
Lab Personnel (2) @ Php44.00/hr	Php264.00
TOTAL	**Php264.00**

In one batch production, **160 pieces of bar soap is produced. A batch production incurred two (2) hours of labor and one (1) hour packaging.

COST per **BAR SOAP** =

$$\left(\frac{Materials + Labor}{No.\ of\ Products\ produced}\right)$$

$$\left(\frac{Php1001.00 + Php264.00}{160\ pieces}\right)$$

Php7.90625

Price of Antimicrobial Bar Soap in the market

= Cost + Profit

= Php7.90625 + Php1.09375

= Php9.00 per piece

Fig. 1. Cost analysis on the antimicrobial bar soap

LAB MADE ETHYL ALCOHOL

MATERIALS	PRICE PER BATCH PRODUCTION
bioethanol from *Nypa fruticans* (Nipa)	Php100.00
Glycerine	50.00
Hydrogen Peroxide	20.00
Distilled Water	20.00
TOTAL	**Php190.00**

LABOR	PER HOUR BASIS
Lab Personnel (2) @ Php44.00/hour	Php88.00
TOTAL	**Php88.00**

In one batch production, **8 pieces of 500 mL of lab made ethyl alcohol is produced. A batch production incurred one (1) hour of labor.

COST per **LAB MADE ETHYL ALCOHOL =**

$$\left(\frac{Materials + Labor}{No.\ of\ Products\ produced}\right)$$

$$\left(\frac{Php190.00 + Php88.00}{8\ pieces}\right)$$

Php34.75

Price of Lab Made Ethyl Alcohol **= Cost + Profit**

= Php34.75 + Php5.25

= Php40.00 per 500mL

Fig. 2. Cost analysis on the lab-made ethyl alcohol

This research and development initiative leverages the natural resources of Northern Samar to address the pressing needs of the local community amidst the COVID-19 pandemic and beyond. By harnessing the indigenous resources abundant in the region, the university seeks to bolster community resilience and response efforts against the ongoing health crisis.

The overarching objective of this initiative is to extend the university's community engagement by providing essential support to the people of Northern Samar in their battle against COVID-19. Through the implementation of this project, the university aims to furnish much-needed security and assistance to the province's residents, thereby enhancing their capacity to combat the pandemic effectively.

Looking ahead, beyond the immediate challenges posed by the pandemic, the university envisages the continuation of its community outreach efforts through an extension program. This program is designed to impart valuable knowledge and skills to local government units, empowering them to produce antimicrobial cloth facemasks utilizing the region's available resources. By equipping local stakeholders with the necessary expertise and resources, the university endeavors to foster sustainable solutions and resilience within the community, ensuring preparedness for future health emergencies.

MATERIALS & PRODUCTION EXPENSES	PRICE
MATERIALS AND OTHER EXPENSES (in 3 months)	
PVK	Php300,000.00
Glycerol	240,000.00
Sorbitol	240,000.00
Non-woven textile	900,000.00
Threads	200,000.00
Needles	200,000.00
Distilled water	200,000.00
Packaging Materials	150,000.00
Cutting Materials	10,000.00
Binders for the nipa biocomposite solution	100,000.00
Caustic Soda	150,000.00
Communication Expenses	40,000.00
Utilities	20,000.00
LABOR	
Laborer (4 sewers) @ Php300.00/day x 3 months *(at most there are 20 working days in a month)*	72,000.00
Honorarium (Project Leader) @ Php8,8000.00 x 3 months	26,400.00
Honorarium (Project Member) @ Php7,500.00 x 3 months	22,500.00
TOTAL	**Php2,870,900.00**
COST per **FACE MASK =**	$\left(\frac{Materials + Labor}{No.\ of\ Products\ produced}\right)$
	$\left(\frac{Php2{,}870{,}900.00}{380{,}000\ pieces}\right)$
Production Cost	**Php7.555**
Mark Up	**Php1.445**
Price Per Unit *	**Php9.00 per piece**

Fig. 3. Cost analysis of antibacterial facemask

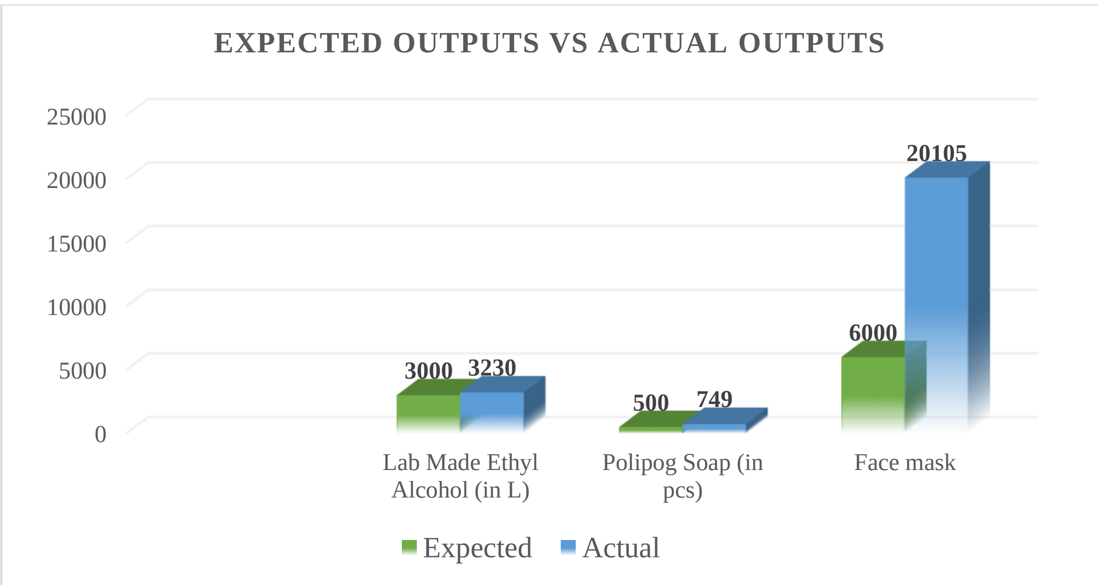

Fig. 4. Visual representation of the produced sanitary items

As evidenced by the data presented in Fig. 4, the outcomes of the project surpassed initial projections. Notably, there was a remarkable escalation in production levels, with the production of bar soap alone exhibiting a 200% increase compared to anticipated figures. Similarly, the output of face masks experienced a substantial surge, recording a 235% augmentation from the originally projected output.

This notable achievement can be attributed to the unwavering support extended by the university administration, coupled with the financial assistance provided by the Philippine Commission on Higher Education. Their backing facilitated the project's implementation and enabled the attainment of commendable results.

The produced sanitary items were subsequently disseminated to local communities residing in Northern Samar, aimed at bolstering their capacity to combat the transmission of COVID-19. Notably, the distribution process was facilitated with remarkable efficiency, owing to the collaborative efforts and support extended by the Provincial Government of Northern Samar (PGNS). Their cooperation ensured a seamless and expedited distribution process, thereby enhancing the accessibility of these essential items to the target population.

4. CONCLUSION

In the endeavor to curb the transmission of the formidable COVID-19 virus, the utilization of indigenous resources from Northern Samar emerges as pivotal. Notably, Nypa fruticans and Salacia korthalsiana Miq. have been harnessed to yield essential sanitary products, including bioethanol, liquid soap, bar soap, and face masks treated with an antibacterial coating. This strategic utilization of local natural resources holds significant potential to exert a profound impact on the surrounding communities.

Empirical evidence underscores the efficacy of this approach, revealing that the infusion of additional funding from the Commission on Higher Education (CHED) correlates with a notable escalation in the project's targeted output. Specifically, a substantial 200% increase in the production of both bar soap and face masks has been observed, underscoring the tangible benefits derived from enhanced financial support.

Subsequently, the manufactured sanitary items have been methodically distributed to local communities most in need, facilitated by the collaborative efforts of the Provincial Government of Northern Samar (PGNS). This concerted endeavor ensures equitable access to essential resources, thereby fortifying the resilience of communities in the face of the ongoing public health crisis.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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