Colegio de Postgraduados

Pitahaya (*Hylocereus undatus* [Haworth] Britton & Rose) marketing margins for its sustainable development in Belize

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ABSTRACT

Objective: To determine the marketing margins and direct participation of producers in Belize aimed to support the sustainable development of pitahaya.

Design/Methodology/Approach: The information was collected between October and December 2022, implementing participatory workshops with producers and members of the pitahaya production chain in the Cayo and Orange Walk districts, Belize.

Results: The producer and the consumer (90%) are the main participating agents of the pitahaya marketing process. The gross marketing margin amounted to 40%, which indicated that, for every dollar paid by pitahaya consumers, 40 cents went to the intermediaries, while 60 cents went to the producers.

Study Limitations/Implications: An in-depth market analysis should be carried out.

Findings/Conclusions: Pitahaya cultivation is just starting in Belize. Nevertheless, the country's climate provides it with a high potential for success. The main marketing channel is made up of the producer and the final consumer. Belizean producers obtained 60% of the total price paid by the final consumer.

Keywords: Commercialization, potential, new crops.

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INTRODUCTION

The primary sector of the Belizean economy accounts for 12.8% of the GDP and it is mainly focused on sugarcane, banana, citrus, and grain production, for both the domestic and international markets. In 2021, the agricultural sector contributed US$312,062,652 to the Belizean economy and banana was the most valuable fruit, providing US$46 million of the total GDP (Canto, 2021). Nevertheless, the Belizean market demands other fruits, such as pitahaya —a fruit that is mainly used by the restaurant sector.

Pitahaya (*Hylocereus undatus* [Haworth] Britton & Rose) or dragon fruit is an exotic fruit that —as a result of its physicochemical and nutritional characteristics and bioactive compounds— is currently expanding to different areas of the world (Attar *et al.*, 2022; Mordorintelligence, 2024).

According to the Ministry of Agriculture, Food Security, and Enterprise of Belize, 38,000 pounds of pitahaya were produced in 26 acres of two districts. Although pitahaya cultivation is just starting in Belize, it has drawn the attention of the Ministry as an ideal crop for small producers, due to its economic and nutritional potential (Martínez *et al.*, 2024). In addition, this crop can obtain significant yields (Osuna *et al.*, 2016) and Belize has the right weather conditions for its development. However, the analysis of the market components of non-traditional crops with development potential (*e.g.*, pitahaya), as a consequence of its different uses, has become a fundamental task in the agricultural sector for the sustainable development of such crops (Mendoza, 2022).

Pitahaya production in Belize is carried out in backyard farming and it is commercialized in local markets and roadside stands. Although there are several pitahaya varieties, fruits with both red skin and pulp are visually more attractive and are more appreciated by the markets than those with red skin and white pulp. In response to the demand for this fruit, the Belizean government and the Mexican Instituto de Investigaciones Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) are working together to develop promotion production programs. These programs include the use of a technological package that will help to solve seasonality and post-harvest problems, improving pitahaya crops and strengthening technical capacities. Nevertheless, the lack of commercialization plans can result in overproduction and waste. Consequently, determining production costs and commercialization channels will provide key data for the improvement of the decision-making process, establishing productive and commercial strategies (Durán and Zolano, 2019). Marketing margins seek to cover costs and market risks, as well as to generate a profit for the agents involved in the process. In addition, the producer influence on the final price of the product covers seed costs, labor, supplies, and agricultural risks (Iregui, 2003). There is scarce information about the production and commercialization systems involved in the pitahaya crops of Belize. Therefore, the objective of this research was to determine the influence of the marketing margins and the direct participation of pitahaya producers in Belize on the sustainable development of this crop. The hypothesis was that the intermediaries obtain most of the marketing margins.

MATERIALS AND METHODS

Study area

Belize has a border with the Mexican states of Quintana Roo and Campeche and with Guatemala. It has 22,800 km² and is divided into six districts: Belize, Cayo, Corozal, Orange Walk, Stann Creek, and Toledo (Figure 1).

The study was carried out in the two district of Belize that, according to the Ministry of Agriculture, Food Security, and Enterprise, have the highest pitahaya production potential: Orange Walk and Cayo, with a pitahaya sowing area of 87.2% and 12.8%, respectively.

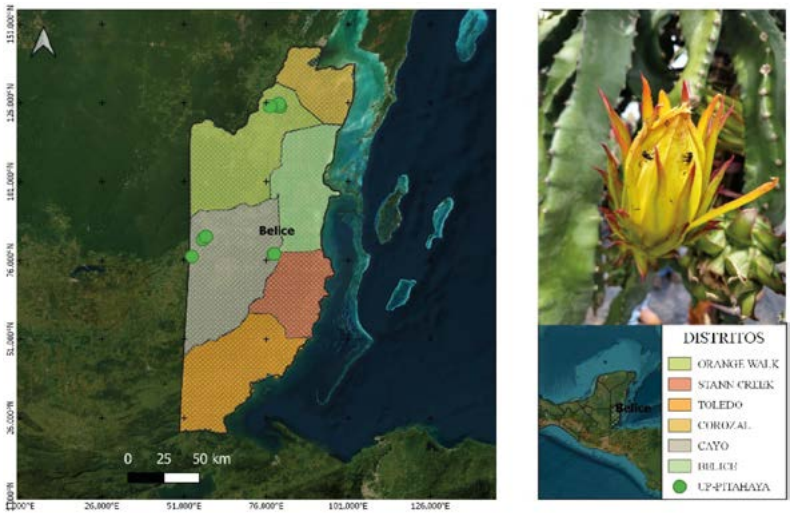

Figure 1. Geographical distribution of pitahaya production in Belize (2023). Source: Figure developed by the authors with data from the Ministry of Agriculture, Food Security, and Enterprise of Belize.

Data collection

Data were collected between October and December 2022, through the implementation of three participative workshops, with 99 participants. These workshops included members with key information and members of the productive pitahaya productive chain (producers, researchers, and traders). Pitahaya crop production costs, marketing margins, and commercial strategies and actions were identified (González *et al.*, 2014).

Marketing margin

The direct method was used to identify the commercialization channels: the pitahaya commercialization channel was monitored from the moment the fresh fruit left the plot to moment when it reached the final consumer. Based on the methodology proposed by Mendoza (1991), the average sell and buy prices were taken into account to determine the absolute (a) and relative (r) marketing margins. The calculus was carried out by price difference between the different market stages and levels; in all the cases, it was connected to the final price paid by the final consumer. The marketing margins and producer direct participation were estimated as follows:

$$GCM(a) = CP - PP \quad \text{and} \quad GCM(r) = \left(GCM(a) / CP\right) \times 100$$

Where: *GCM* is the gross commercial margin, *CP* is the price paid by the consumer, *PP* is the producer price.

The producer direct participation (PDP) was determined as follows:

$$PDP(a) = CP - GCM \quad \text{and} \quad PDP(r) = \left(PDP(a) / CP\right) \times 100$$

The data were processed and analyzed through descriptive statistics, using the IBM SPSS v11.0 statistical package for social sciences.

RESULTS AND DISCUSSION

Technological package proposal

The training was directed to Belizean technicians and producers, who were introduced to the pitahaya technological package developed at the Campo Experimental Cotaxtla (INIFAP). The establishment of live plant tutors was fundamental. The *Bursera simaruba* species was chosen for this purpose. The participants were told that the transplant should be carried out when the tutors had sprouts and showed an optimal apprehension (approximately three months). The recommended sowing density was 4×2 m, in a planting frame or square, which resulted in a 1,250-tutor density. An additional recommendation was to sow two plants per tutor, resulting in 2,500 pitahaya plants per hectare (Del Ángel *et al.*, 2012). This training provided an in-depth analysis about the supplies required for the transplant: 5 kg of compost or vermicompost per stock. In addition, participants were trained in the following cultural labors: formative and maintenance pruning, thinning, tutor pruning, pest and disease control, weed control, and harvesting. During the training, all the producers (80.80% men and 19.19% women) showed great interest in the technological package proposed. Field evaluations were carried out to measure the advancement of the producers after the training. The results showed that 80% of them were applying the technological package.

Analysis of the production costs

There is no information about the production cost of dragon fruit per hectare in Belize, because production is mainly carried out in family farming or small plots. According to the technological package, the costs are divided into establishment and maintenance costs. Plantation (73.9%) is the highest costs for the producer during the pitahaya plot establishment, followed by solid fertilization (16%). The main costs during the maintenance years are fertilization and weed control, reaching 50.6% and 13%, respectively (Figure 2).

The total production costs for 2023 —which account for crop establishment and maintenance during the first year— reached $9,491.18 BZD/ha (US$4,709.38/ha), while the average yield from the second year amounted to 11.25 t h^{-1}. Consequently, the gross income was $43,074.08 BZD/h (US$21,372.69/ha). The yield in Belize was more competitive than in Mexico. The Mexican states of Puebla, Yucatan, Quintana Roo, Campeche, Chiapas, Tabasco, and Veracruz recorded a yield that fluctuated between 3.5 and 16 t h^{-1} (Del Ángel *et al.*, 2022).

Meanwhile, the production cost proposed matched the reports of Diéguez-Santana *et al.* (2022), who pointed out that pitahaya production costs in Ecuador fluctuated between US$5,015 and US$6,935 per hectare.

Commercialization agents

In Belize, fresh pitahaya is locally commercialized by 90% of the producers. All (100%) the producers emphasized that the main problem they face is oversupply, which in turn

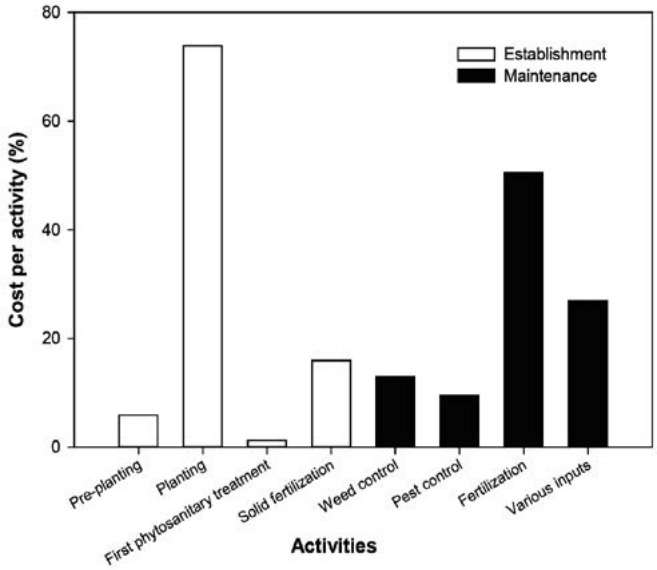

Figure 2. Pitahaya production costs during its establishment and maintenance.

creates competition between the small producers of the district. In addition, consumers are not aware of the product or its health benefits. A similar situation takes place in countries such as Costa Rica, where the use of pitahaya is not spread among the local population and it is mainly consumed by foreign residents in the country (García and Quirós, 2010).

Pitahaya production is aimed at domestic consumption, but it is not equally distributed in the country. Pitahaya fruits are mainly consumed within the neighboring localities of the production units. The price of pitahaya in roadside family stands is relatively low: an average of $3 BZD per pound (US$1.49).

Meanwhile, consumers have a diverse profile regarding income, schooling, age, purchase motive, and place of residence. Tourists are a potential market, because they are attracted by the exotic color of this tropical fruit. They have different purchase patterns regarding food souvenirs (García *et al.*, 2022). Lin (2017) mentioned that, in Asia, food is one of the favorite gift options for tourists. Consequently, developing strategies to manage, plan, commercialize, and position pitahaya fruits as a tourism resource within the destination is fundamental. In addition, the market should be divided into subgroups, in order to offer appropriate products and services. According to Sánchez-Sánchez (2022), segmentation is the division of the market into smaller portions, depending on its characteristics.

Nevertheless, 10% of the producers sell fresh fruit to wholesalers and plant cuttings to other producers. They also manufacture ice-cream, aguas frescas, marmalade, and other products. Nowadays, markets are highly competitive and, therefore, generating added value and obtaining strategic advantages are key factors to guarantee consumer satisfaction (Torres and Guerra, 2022).

Consequently, the gross marketing margin of pitahaya was 40%, indicating that intermediaries keep 40 cents of each Belize dollar paid by consumers, while pitahaya producers earned 60 cents. In other words, intermediaries obtain 40% of the final price paid by the consumer: $2 BZD per pound (US$0.99) (Table 1).

Table 1. Absolute and relative marketing margins and producer participation in the final price of pitahaya.

Item	**Value (bzd/libra)**	
Producer price	3.0	
Wholeseller price	4.0	
Consumer price	5.0	
	Absolute (bzd/pieza)	**Relative (%)**
Gross sales margin	2.0	40.0
Producer share	3.0	60.0

Source: Table developed by the authors (2022).

Kohls and Joseph (1990) reported similar results: processed products automatically have a higher marketing margin than fresh or non-processed products. When the product is sold outside the production unit, the marketing margin is lower. In this case, the margin can even be null, because the producer obtains 100% of the product price and only one transaction takes place (producer-consumer). In Germany, approximately 11% of all the fruits and vegetables are directly sold by the producer to the consumer (Dent and Macharia, 2017). The percentage in Mexico is lower, as a consequence of the long distances between the consumption and the production areas, as well as the land route infrastructure. Reducing the intermediaries is not always possible, as a result of the role they play in the commercialization, despite the costs they generate. In addition, markets have become increasingly demanding; consequently, a greater number of highly specialized intermediaries is sometimes required to achieve a higher efficiency (Álvarez *et al.*, 2021).

Commercial strategy

The workshops established the commercial strategies and actions to be followed for the improvement of the crop commercialization (Table 2).

Table 2. Commercial strategies and actions for pitahaya cultivation.

Strategy	**Actions**
Knowledge and capacity building	• Training modules and workshops on marketing, by-product processing, post-harvest handling, agribusiness management.
Stakeholder organization models	• Formation of producers' organizations in associative figures. • Integration of chain actors into legal organizations.
Follow-up and evaluation of basic actions in the commercial system	• Implementation of a commercial technical assistance program.
Establishment of infrastructure and equipment for marketing and industrialization	• Creation of collection, packing and preservation centers for fresh fruit. • Construction and equipping of pitahaya industrialization centers.
Market diagnosis and planning	• Preparation of a market study at the CARICOM level.
Financing schemes for stakeholders	• Formation of a financial fund for members of the production chain.
Legal and regulatory framework	• Dissemination of national and international quality standards for pitahaya.

Pitahaya is an agricultural alternative in regions with scarce water resources, because it thrives under limiting weather conditions. In addition, pitahaya has a competitive price in local, regional, domestic, and international markets (Montesinos-Cruz *et al.*, 2015).

CONCLUSIONS

Pitahaya cultivation is just starting in Belize, and it has a high potential due to the climate of the country and the nutraceutical properties of the fruit. The main commercialization channel is mainly made up by the producer and the final consumer. Belizean producers obtained 60% of the final price paid by the consumer. Nevertheless, training producers regarding technical and commercial activities is fundamental to expand the market and to offer quality fruit. The marketing margin analysis does not show profits or losses for the producers or the intermediaries. In truth, the market and the product itself define the extension of the commercialization channel, the time and storing type, the way in which a product is processed, the transportation, and the means of transport.

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