







# Evaluation of the use of artificial bait based on jackfruit (*Artocarpus heterophyllus*) meal as lure for freshwater crustaceans: a preliminary study

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## ABSTRACT

**Objective:** To evaluate the effectiveness of an artificial bait made from jackfruit flour (*Artocarpus heterophyllus*) in capturing freshwater crustaceans by pot fishing was evaluated, comparing it with a traditional coconut paste bait.

**Design/methodology/approach:** Experimental trials were conducted with *Cherax quadricarinatus*, *Macrobrachium tenellum*, and *Procambarus clarkii* in controlled ponds.

**Results:** For *M. tenellum*, the jackfruit flour bait was more effective than the coconut paste bait, showing significant differences. For *C. quadricarinatus* and *P. clarkii*, no statistical differences were found in the number of organisms captured between the two baits.

**Findings/conclusions:** These findings suggest that jackfruit flour could be a viable and sustainable alternative bait in crustacean fisheries, reducing the dependence on animal-based baits. Further research under natural conditions is recommended to optimize its formulation and evaluate its impact on species selectivity.

**Keywords:** Fisheries, attractors, jackfruit flour, nasa traps.

## INTRODUCTION

Fishing freshwater crustaceans represents an economic and food activity of great importance in various regions of the world, including México (Buhaya-Lora & Ramírez-Partida, 2013). Catch efficiency in this type of fishery depends largely on the type of bait used, which must be attractive to the target species, economically viable and environmentally sustainable (Karunanithi *et al.*, 2018). Traditionally, various types of natural and artificial baits have been used, including coconut paste, which has proven to be

effective due to its high oil content and its ability to attract crustaceans by releasing volatile compounds into the water (García Hernández *et al.*, 2015). The use of coconut fruit (*Cocos nucifera*) as bait in fisheries has been the subject of study and innovation in various regions. Research has shown that coconut paste, a by-product of oil extraction, can be used to create effective artificial baits for catching aquatic organisms using traps. This application not only revalorizes a low-cost by-product, but also offers a sustainable alternative to fresh baits, allowing their use throughout the year and improving fishing efficiency (Nolasco-Soria, 2014). In addition, in some fishing practices it has been observed that the use of coconut pieces can attract certain species, although the effectiveness of this method may vary depending on the region and the target species. For example, conversation among fishermen mention the use of “coconut” as bait, possibly referring to parts of the fruit, although the exact preparation and presentation is not specified (personal communication with fishermen from the Cajón de Peñas dam). Pacho *et al.* (2021) reported the use of roasted coconut to release its aroma before placing it in traps wrapped in nets in a fishery for different *Macrobrachium* species.

The results showed that traps with low-value fish were the most effective, especially the plastic ones. Roasted coconut, although it attracted some shrimp, had a lower catch rate compared to other baits, such as low-value fish and octopus. In the search for new alternatives, the fruit of the tropical tree *Artocarpus heterophyllus* commonly known as yaca, jaca, nanca, mangea or panapén has been identified. Jackfruit meal possesses several nutritional properties that make it viable as bait in freshwater crustacean fisheries (Ngurthankhumi *et al.*, 2024). Its high carbohydrate content, mainly starches and natural sugars, acts as a source of energy and attractant for aquatic organisms; its protein supply favors the release of nitrogenous compounds into the water, which can stimulate the response of crustaceans (Clerici & Carvalho-Silva, 2011). Although in lower proportion than other baits such as coconut paste, jackfruit meal contains lipids and essential oils that favor the dispersion of aromatic compounds in the water, while its volatile and phenolic compounds generate a characteristic aroma that could enhance its attractiveness and effectiveness in the capture of crustaceans (Cruz-Cansino *et al.*, 2021). Finally, its high dietary fiber content gives it structural stability, allowing greater durability in water and reducing its premature degradation, making it a potentially efficient and sustainable option for use in pot fishing (Clerici & Carvalho-Silva, 2011).

The objective of this study is to evaluate the use of an artificial bait based on jackfruit meal in the capture of freshwater crustaceans and to compare it with a traditional bait based on coconut paste. The effectiveness of both baits will be analyzed in terms of the quantity and type of crustaceans captured. With this, we seek to determine the viability of using jackfruit meal as a sustainable and economic alternative for freshwater fishing, thus promoting the integral use of this fruit and the diversification of inputs in the fishing activity.

## MATERIALS AND METHODS

The study was carried out at the Laboratorio de Calidad de agua y Acuicultura experimental (LACUIC) of the Universidad de Guadalajara, located at the Centro

Universitario de la Costa in Puerto Vallarta, Jalisco, México. Six fruits of *A. heterophyllus* with an average weight of  $4.18 \pm 0.5$  kg were used, from which only the pulp was extracted, discarding the seeds and peels. The extracted pulp was subjected to a drying process in a convection oven (NOVATECH<sup>®</sup>) at 60 °C for 48 h. Afterwards, the pulp was ground to a fine powder using a grain mill (Hamilton Beach 80335r). For the preparation of the artificial bait, jackfruit flour was used to which binders were added (gelatin and Pegabind<sup>®</sup>) (Table 1), with the objective of obtaining a gelatin that was poured into a metal tray to form a layer approximately 1.0 cm thick. Following the same methodology, a control bait was prepared based on coconut paste (*Cocos nucifera*), obtained from the company DUSTRY GROUP<sup>®</sup> according to the patent proposed by Nolasco-Soria *et al.* (2014) (MX2014015122).

For the evaluation of the baits, three plastic ponds (Rotoplas<sup>®</sup>) with a capacity of 1,700 L each were used. In each pond, considered an experimental unit (EU), 22 Australian lobsters (*Cherax quadricarinatus*), 96 crayfish (*Macrobrachium tenellum*) and 13 American red crayfish (*Procambarus clarkii*), all from the laboratory stock, were introduced. Prior to the start of the experiment, the organisms were subjected to a 24 h fasting period to standardize their hunger level and avoid biases in the response to the bait. Subsequently, one nase trap was set per experimental unit. The traps had a rectangular wire structure covered with mesh and dimensions of 50 cm long, 23 cm wide and 23 cm high, with two lateral entrances to facilitate the entry of the organisms. The baits were prepared in the form of squares of 50 g each and placed inside the traps. To minimize location bias, the traps were randomly distributed within the ponds. The traps remained submerged for 24 hours. At the end of this period, they were carefully removed to avoid loss of organisms, and the total number of captures of each species was counted. Finally, to determine significant differences in the predilection for each type of bait, the data obtained were analyzed using a  $\chi^2$  contingency table for two independent samples. The assumptions of the test were verified and statistical corrections were applied when necessary, establishing a significance level of  $\alpha=0.05$ .

## RESULTS AND DISCUSSION

Trap fishing is one of the most widely used techniques worldwide, and its success depends largely on the efficiency of the bait used, either of natural or artificial origin, depending

**Table 1.** Composition and function of ingredients in the preparation of artificial bait for catching freshwater crustaceans.

Ingredients	Quantity (g/kg)	Function	Description
Jackfruit/Coconut Flour	400	Attractant molecules	Contains carbohydrates, proteins, and volatile compounds that can attract crustaceans.
Gelatin	50	Protein gelling agent	Protein that helps give consistency to the mixture.
Pegabind	50	Synthetic binding agent	Improves the cohesion of the bait in the water, preventing rapid dissolution.
Agua*	q. s. ( $\approx$ 1 L)	1 L to make the gelling mixture	Allows the formation of a gel matrix.

(\*) q. s. = amount sufficient to complete.

on the target species (Masilan & Neethiselvan 2018). Traditionally, fishermen have used species such as squid (*Dosidicus gigas*), mackerel (*Scomber japonicus*), mullet (*Mugil cephalus*) and skipjack (*Katsuwonus pelamis*) as bait, however, these species are of high nutritional value and should be prioritized for human consumption (FAO, 2022).

In addition, the cost of bait increases considerably when these resources are scarce due to seasonality, which forces fishermen to travel long distances in their search, increasing fuel consumption and operating costs (Harnish & Willison, 2008; Spoor *et al.*, 2021). Faced with this problem, the fishing industry has begun to employ more sustainable alternatives, such as fishery remains (heads and guts of fish, bones, shrimp remains, among others), as well as processed fish silage that is placed in nets to gradually release leachates and attract target organisms (Dellinger *et al.*, 2016). Also, artificial baits with various characteristics in terms of texture, shape, size and attractant composition have now been developed. Some mimic small fish that act as natural prey, while others are formulated as stabilized pastes with chemical additives, combining ingredients such as fish, squid and mollusks to enhance their effectiveness (Ollis *et al.*, 2004).

In the present study, jackfruit flour was used as an attractant due to its characteristic odor when ripe (Cervantes-Robles, 2018), combined with a gelling agent that allowed the manufacture of the artificial bait. The results obtained showed differences in the effectiveness of the bait depending on the species captured. In the case of *C. quadricarinatus*, out of a total of 66 organisms used in the test, no significant statistical differences were found in the captures depending on the type of bait. The coconut paste bait resulted in the capture of 18 specimens (27% effectiveness), while the jackfruit flour bait allowed the capture of 9 organisms (14% effectiveness). For *M. tenellum*, there were statistical differences in the number of captures between the two baits. Of the 288 organisms in the ponds, the jackfruit meal bait captured 71 specimens (25% effectiveness), while the coconut paste bait captured 56 specimens (19% effectiveness), indicating a greater preference for the bait based on jackfruit meal in this species. As for *P. clarkii*, out of a total of 40 organisms in the test, no significant statistical differences were found between the baits. With the bait made from jackfruit, 25 organisms were captured (62% effectiveness), while with the coconut paste bait, 22 organisms were captured (55% effectiveness) (Table 2).

These results reinforce what was mentioned by Masilan y Neethiselvan (2018), who emphasize that the key to success in pot fishing lies in the type of bait used. Waddington y Meeuwing (2009) mention that approximately 8.8 million pots are used in the Western lobster (*Panulirus cygnus*) fishery in Western Australia, which implies the use of 14,000 tons of bait per year. This massive addition of organic material to marine ecosystems has

**Table 2.** Results of catches of various organisms in traps baited with coconut paste and jackfruit meal.

Species	Organisms used (n)	Catches with coconut paste (n, %)	Catches with jackfruit meal (n, %)
<i>Cherax quadricarinatus</i>	66	18 (27%)	9 (14%)
<i>Macrobrachium tenellum</i> **	288	56 (19%)	71 (25%) **
<i>Procambarus clarkii</i>	40	22 (55%)	25 (62%)

Significant differences were detected in *Macrobrachium tenellum* by  $\chi^2$  ( $p < 0.05$ ).

been shown to affect their functioning globally, so the development of more efficient and sustainable baits would contribute to both ecosystem conservation and fishery maintenance.

The bait used in our study is of vegetable origin, made with biodegradable products that, if consumed by the organisms, would not represent a negative impact, since they provide proteins and minerals. However, there are few studies that evaluate the use of vegetable baits in crustacean fishing. An example is the work Nolasco-Soria *et al.* (2014), who developed a bait based on hydrolyzed coconut paste for crustacean and freshwater fish fishing, obtaining good results in the capture of both species and managing to consolidate a patent. On the other hand (Ghazilou *et al.*, 2016) compared the use of baits of animal origin (fish remains) and vegetable origin (a combination of raw dough with turmeric), using video recordings in the natural environment to analyze their effect as attractants in fish communities. Their results showed that the animal baits attracted a greater diversity of organisms compared to the plant baits, which only attracted herbivorous species. This suggests that the type of bait directly influences the trophic composition of the organisms captured. Based on our results, it is important to continue research on the effect of plant baits in natural conditions, in order to develop better practices that optimize catches, minimize production costs and reduce the negative environmental impact associated with the use of conventional baits.

## CONCLUSIONS

The present study evaluated the effectiveness of an artificial bait made from jackfruit meal in fishing for freshwater crustaceans and its comparison with a traditional coconut paste bait. The results showed that, although there were no significant differences in the capture of Australian lobster and American red crab, in the case of crayfish, the jackfruit meal bait was more effective than the coconut bait. These findings highlight the viability of the use of plant-based baits as a sustainable alternative in pot fishing, reducing dependence on animal-based baits and reducing the environmental impact of fishing activities. In addition, the implementation of biodegradable and low-cost ingredients, such as jackfruit, could represent an accessible and sustainable option for fishermen. Given that there are few studies on the use of plant-based baits for catching crustaceans, it is recommended that research continues under natural conditions to evaluate their effectiveness on a larger scale. It is also necessary to optimize the bait formulation and analyze its impact on the selectivity of target species. This will allow us to advance towards the development of more efficient and ecologically responsible fishing strategies.

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