



# Percentage of edible part (tail muscles) of spiny lobster *Panulirus penicillatus* (Oliver, 1791) in Sudan Red Sea Coast

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## ABSTRACT

**Background:** This study was carried out in 2019. Eleven specimens of Spiny lobster *Panulirus penicillatus* were sampled from Port Sudan local fish market. Total body weight and edible part (muscles) weight were taken using digital balance. The percentage of edible to non edible parts, varied in range from 18.7% to 26.9%, with an average of 21.65%. The percentage of females was 63.6%, and males was 36.4%. The average carapace length of samples was 8.15 cm, and average total body weight 470.18 g, and average edible part weight was 95.85 g. Total body weight edible part weight relationship showed strong relationship through logarithmic equation, where  $R^2=0.9411$ . The carapace length edible part weight relationships showed high relationship through logarithmic equation, where  $R^2=0.9166$ .

**Keywords:** *Panulirus penicillatus*, Edible, Weight, Percentage, Tail muscle, Carapace, Red sea

## INTRODUCTION

Lobsters are among the largest-bodied and longest-lived modern marine arthropods. (Wolff, 1978; Sheely, 2001) (Phillips, 2006). They are ecologically important as consumers in a variety of temperate and tropical marine ecosystems (Robles C et al., 1990) (Mayfield et al., 2000) (Phillips, 2006). In many parts of the world, lobsters also support commercially valuable fisheries, in some regions the most economically important one (FAO, 2004) (Phillips, 2006). Within the Palinuridae, there are 16 *Panulirus* spp. Known in the Indo-pacific Basin; seven have broad distributions that extend across multiple biogeographical provinces, and four occur from the Red Sea to the Central Pacific. Of these, the pronghorn lobster, *Panulirus penicillatus* (Oliver, 1791) (Holthuis, 1991) is the most broadly distributed (Lacchei et al., 2016). The species is not gregarious and is nocturnal, hiding in the daytime in crevices in the rocks and coral reefs, and moving at

night (Oliver, 1791). In general, palinurids are mainly carnivores, usually feeding upon sluggish, easily capture animals where most material is eaten alive or freshly killed. Lobsters are very popular seafood which was believed to have high nutritional value (Haryono et al., 2015). Lobsters come in range of colors, including greenish-brown, blue, light yellow, dusty orange, and pattered (Nelson et al., 2006). After cooking, all lobsters turn red as a result of a chemical reaction in the shell. Lobster is a great source of B-vitamins, providing your daily recommended intake of B12 and contains calcium, magnesium, phosphorus, potassium, zinc, selenium, choline and vitamin E (Cockcroft et al., 2011)

Lobster also is a good source of essential omega-3 fatty acids. Lobster is naturally carbohydrate-free and has no fiber or sugar (Barbie, 2022).

The Nutrition facts as stated by: (Lobster Spiny, 2014) calories 112, fat calories 14, total fat 1.5 g, saturated fat

0.2 g, cholesterol 70 mg, sodium 117 mg, protein 20.6 g and omega-3 0.4 g. This indicated a high nutritive value of spiny lobster. The species *Panulirus penicillatus* color is green yellow, brown green to blue back. The abdomen is covered with black spots. A distinct blue spot is found at the base of the antenna. It reaches 40 cm in length (Humann et al., 2010). This species occupies large areas compared with the spiny lobsters, it lives on hard bottoms in 1-4 meter depth and it often found in deep caves where surf or strong currents prevail, it is widely spread in the Red Sea (FAO, 1983). Major spawning occurred from May to September. Mature females larger than 6 cm carapace length, spawn at least three times a year while smaller new mature spawn at least once a year (Chang, 2006)

In Sudan the fisheries of spiny lobster is not fully exploited, and no more studied done to know their biology and nutritive value, although, recently it requested and desirable by tourist and restaurants in Khartoum, with very high prices compared with fin fish and other marine living resources. Spiny lobster in Sudan Red Sea caught by artisanal fishers, collected by hands in shallow waters near coral reefs, in small quantities, most of the year female found loaded with orange egg in abdominal side. There are three species of spiny lobster in Sudan. *Panulirus penicillatus* is the most common species of spiny lobster in Sudanese Red Sea coast, beside rarely two species (*Panulirus versicolor* and *Panulirus ornatus*). In spite of that it fished artisanally, and marketed locally fresh, iced or frozen.

## MATERIALS AND METHODS

Spiny lobster species studied was *Panulirus penicillatus* (Oliver, 1791), identified as:

Kingdom: *Animalia*

Phylum: *Arthropoda*

Class: *Malacostraca*

Family: *Palinuridae*

Genus: *Panulirus*

Species: *penicillatus*

English name: *pronghorn spiny lobster*

*Panulirus penicillatus* were sampled from Port Sudan local fish market during the year 2019. Where whole production from different landing sites along Sudan Red Sea coast by artisanal fisheries, brought and marketed locally, fresh or frozen.

-Sex differentiated externally.

-weight in gram was taken using digital balance, for the whole lobster (total body weight) dissection to remove edible part using scissor and small knife, then tail muscle or meat weight was taken. The edible muscle percentage calculated using the formula:

$$\text{Percentage of edible part} = \frac{\text{Tail muscle weight}}{\text{Total body weight}} \times 100$$

-Sex percentage: the percentage of male to female was calculated.

-Statistical analysis take place using Microsoft excel program.

## RESULTS

The percentage of edible part to the total body weight vary with a range of 18.7%-26.9%, with an average 21.6%, with the most common percentage 18.7% (Figures 1 and 2) (Table 1). Total body weight edible part weight relationship showed strong relationship through logarithmic equation, where  $R^2=0.9411$ . The carapace length edible part weight relationships showed high relationship through logarithmic equation, where  $R^2=0.9166$ . The sexes were sampled externally, and differentiation between female and male was easy, the results showed that the dominant sex was female, with a percentage of 63.6%; and male percentage was 36.4%. The carapace length of sampled lobster showed a variation, the minimum length was 6.2 centimeters, and maximum carapace length was 12.2 centimeters, with an average length 8.15 centimeters. Also total body weight varied, the minimum total body weight was 224 grams, and the maximum total body weight was 1243 grams, with an average 470.18 grams (Figure 3).

During this research the most dominant sexes were sampled from Port Sudan local fish market, were females varied in size, and most of them were loaded with eggs (orange in its color) most of the months of the year (Figure 4). The total body weight edible part weight relationship showed in Figure 5. Where  $R^2=0.9411$  showed high relationship.

Carapace length edible part relationship, through logarithmic plotting equation, showed high relation where  $R^2=0.9166$  (Figure 6) showing the relationship between carapace length and edible part (tail muscle) relationship.

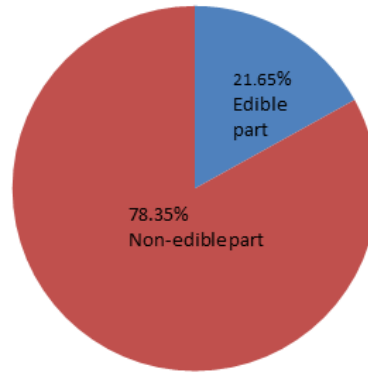


Figure 1: Showing percentage of edible part to total body weight.

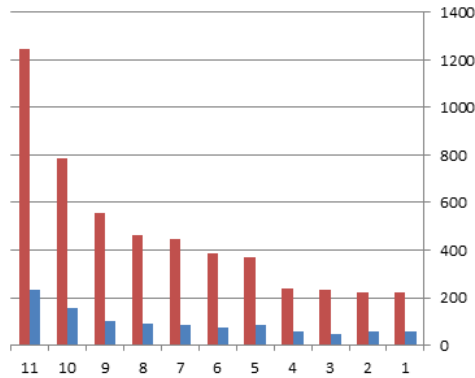


Figure 2: Percentage edible weight to total body weight of *Panulirus penicillatus*.

Table 1: Showing the Carapace length (cm), total body weight (g), edible weight (g), % of edible part, and sex.

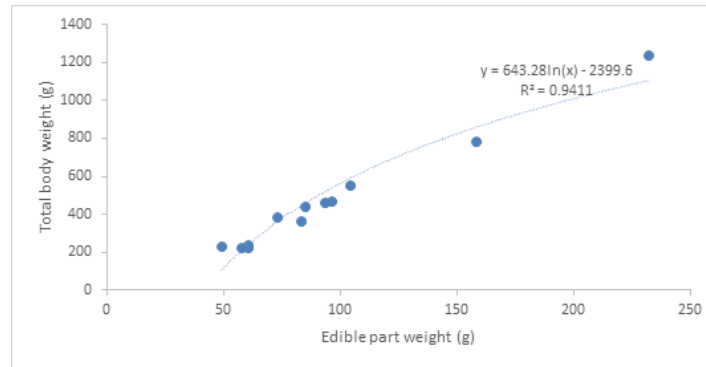
Carapace length (cm)	Total weight (g)	Edible part weight (g)	Percentage edible part %	Sex
6.2	224	60.2	26.9	F
5.9	224	57.3	23.5	F
6.6	235	49	20.9	M
6.6	237	60.4	25.5	F
8.1	368	83	22.6	F
8.6	388	73	18.8	F
7.8	445	84.5	19	F
8	465	93	20	M
8.4	555	104	18.7	M
11.2	788	158	23.5	M
12.2	1243	232	18.7	F
Average				
8.15	470.18	95.85	21.65	Sex



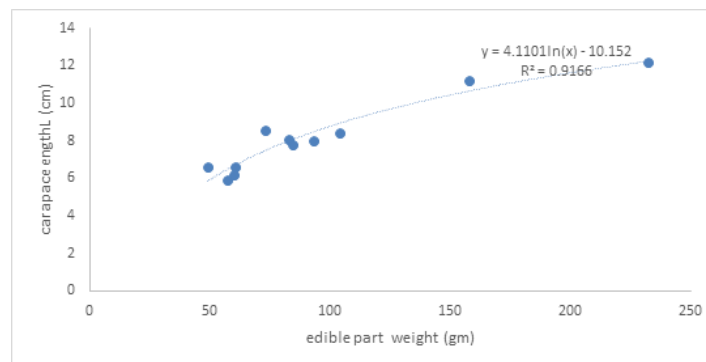
Figure 3: Tail muscle (meat) on right hand.



**Figure 4:** *Panulirus penicillatus* female loaded with egg.



**Figure 5:** Total body weight-edible part weight relationship. **Note:**  $R^2 = 0.9411$  showed high relationship.



**Figure 6:** Showing carapace length-edible part weight relationship. **Note:** Carapace length- edible part relationship, through logarithmic plotting equation, showed high relation where  $R^2 = 0.9166$ .

## DISCUSSION

The samples of this study showed a variation in size, and sex. The carapace length was ranged from 12.2 centimeter to 5.9 centimeter with an average 8.15 centimeter, and the total lobster body weight was ranged from 1243 gram to 224 gram, with an average 470.18 gram, this indicated that the random samples of this study represent different lobster size. Percentage of edible part to total body weight varied accordingly depending of different in lobster size, so the range of percentage edible parts was 26.9% to 18.7%, with an average 21.65% of total body weight. Total body weight edible part weight relationship showed that, there is high relationship ( $R^2 = 0.9411$ ). Carapace length edible part relationship showed high relation ( $R^2 = 0.9166$ ). The

research results of this study agreed to some extent with (Bifadni, 2016) which found the edible parts of *Panulirus penicillatus* range between 15.6% to 30.3% of total body weight. The variation in edible part (tail muscle) percentage may due to seasonality (temperature, nutrients availability, spawning period) or to site from which lobster was caught and metabolism, because in rainy season the terrestrial drainage waters enter the sea and enrich the marine ecosystems with organic nutrients. Also it may affected by reproductive season, so seasonality is so important to be considered in these types of researches. Although the price of spiny lobster is very high locally and globally, commercially valuable, but the edible part is too low compared with the total body weight, and price. This to some extent agreed with (Lobster spiny, 2014) "spiny



lobster tail meat, which accounts for 33 percent of the body weight, *panulirus* and *jasus* species are the most valuable lobster". Also agreed with (Spiny Lobster, 2004) "lobsters considered a high-value dish and market demand as well as price are high end, compared with other sea food products". When you buy kilogram of lobster you will obtain only about 18.7% to 26.9% meat, the rest of lobster will be as a waste, and this waste should be treated and used as a source of calcium (by-product) and adding value, to be used in poultry and aquaculture feeding. Also the lobster body can be used in decoration and for educational purposes (by putting them in museum and laboratories of schools and universities). Although of the high nutritive value, and health benefits of lobster meat, but unfortunately it didn't eaten by the local people of Port Sudan, this may refer to the high price and limited income, or to the lack of information about the value and benefit of eating lobster, or may due to the both. The most important results from this research, that the females which were caught through research period loaded with egg, this can lead to decline and deterioration of lobster fisheries in Sudan Red Sea Coast, and if no management plan and measures taken out, the current fishing practice, can lead to overfishing and lobster fisheries may declined or lost. Although the fishing of spiny lobster, locally very limited, but with time the ecological, and socio-economical impacts will be visible. Actually at present there is lack of lobster management plan or management action taking place, and the evidence, the existence of loaded female bought and sold in local fish market of Port Sudan without accounting or penalty.

## CONCLUSION

In this study the maximum percentage edible part is near to 27% as the highest percentage with remains or wastes (such as carapace, tail, legs and antennas) is about 73%, the minimum percentage is about near to 19%, with remains (wastes) is about 81%, this large amount or weight of remains or wastes should be treated and translated to useful products such as supplementary food, added to poultry or aquaculture feeding as a source of calcium, or could be used as (a whole creature) in decoration purposes, this will be a part of future research in Red Sea Fisheries Research Station, to reduce waste and increase socio-economic benefits. Also future studies will concentrated on chemical composition, reproductive biology and farming of spiny lobster in Sudan.

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