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A Red Seaweed from Eastern Sicily: Chondracanthus Teedei, called "Màuru"

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Summary

Much of the research conducted in recent decades has involved the identification of alternative foods capable of filling the growing demand for proteins and reducing the phenomenon of greenhouse gases, also thanks to their content of antimethanigenic substances. For this reason, many researchers have focused their attention on algae in general and red algae in particular. This note reports the results of the analyzes carried out on the red macroalga Chondracanthus teedei, widespread in a restricted area of eastern Sicily, where it is known by the dialectal name of "Màuru", to highlight its main bromatological characteristics. The results obtained show a good carbohydrate and protein content and a high ash content (39.46, 38.3 and 20.68%, respectively) on dry matter (DM) basin. The protein is of good value for having a percentage content of essential amino acids, similar to that of egg; the ashes have an optimal sodium and potassium content (~ 1: 1) and a high iodine content. Although the results obtained are comparable to those found in other red algae, of the same species and of other species, further investigations would be desirable, both to highlight any seasonal and / or environmental variability, and to determine the content in other interesting bioactive substances, such as, for example, fatty acids, antimethanigenic substances, heavy metals

Keywords: Chondracanthus teedei; Red algae; Bromatological characteristics

Introduction

In recent decades, the demand for food protein sources has visibly increased, especially in developed countries; global protein demand is expected to double between 2020 and 2050 [1]. A solution to the problem could be to resort to alternative protein sources such as insects which have high protein content and provide essential amino acids; the total protein level varies according to the stage of life and varies between approximately 50 and 80%. Due to relatively low consumer acceptance, incorporating insect proteins into food products still poses a significant challenge [2,3]. The increase in animal husbandry cannot be a viable solution due to their negative impact on the environment, including, among others, the production of greenhouse gases [4]. According to the 2019 FAO report, animal farms contribute about 14% to the production of greenhouse gases [5]. In particular, most greenhouse gas emissions from livestock production are in the form of methane (CH4), which is produced largely through enteric fermentation, representing a loss in food energy consumption, and to a lesser extent, the decomposition of manure [6]. For this reason, many studies have been carried out to reduce enteric emissions of CH4 through the use of food additives, dietary manipulation and the quality of forage [7].

Another alternative protein source is represented by algae. Algae have positive health effects such as immune regulation, radiation protection, skin whitening effect, blood pressure, fat, sugar reduction, Alzheimer's disease alteration and delay, promotion bowel health, reducing the risk of osteoporosis and cardiovascular disease [8,9]. The beneficial properties of algae depend on the presence of bioactive compounds with anti-inflammatory, antimicrobial, antioxidant and antitumor characteristics [10,11].

The edible aquatic macroalgae are classified into three main groups based on the composition of photosynthetic pigments present, red seaweed (Rhodophyta), brown seaweed (Ochrophyta, Phaeophyceae), and green seaweed (Chlorophyta). Many studies have involved red algae. Red algae have a higher protein content (10-40%) than green or brown algae [12]. The most active proteins are lectin and phycobiliprotein. Lectins are

glycoproteins with biological control functions; phycobiliproteins are chromoproteins with anti-inflammatory, hepatoprotective and antioxidant functions [13] (Pooja, 2020).

They have a good content of essential amino acids even if some authors find a lack of methionine, cystine and lysine [14]. They possess water-soluble pigments, used as food dyes [15], polysaccharides with gelling properties such as agar, carrageenan and alginates applied in the food, biomedical, pharmaceutical and biotechnological industries [16]. Some red algae have antimethanogenic properties due to their ability to synthesize halogenated analogues of CH4, such as bromoform and dibromochloromethane, within specialized glandular cells as a natural defense mechanism [17].

Several studies have been conducted on the antimethanogenic power and on the mechanisms of action of synthetic additives, nitro and halogenated compounds, and natural halogenated compounds synthesized from algae [18-26]. Other studies, conducted in Australia, tested the antimethanigenic power, both in vitro and in vivo, of red algae [27-32]. The aim of the present was to analyze a red alga belonging to the Chondracanthus species, Chondracanthus teedei, present in the coasts of eastern Sicily, known by the dialectal name of "Màuru" [33].

Chondracanthus derives from the Greek words chondrus (cartilage) and akanthos (thorn, alluding to its thorny aspect); and Teedei derives from the name of its collector, the British Tedde [34]. This edible seaweed once grew luxuriantly on the coasts of the Ionian coast; today, unfortunately, finding it represents a real stroke of luck: due to the pollution of the seas, this alga is no longer able to grow, precisely because it finds no conditions for survival except in clear and uncontaminated waters. Thanks to the help of the fishermen in the area, it was possible to find a suitable quantity to carry out the analyzes that are the subject of this study.

Materials and Methods

Analyzes relating to the chemical composition were carried out on dried samples of the red macroalgae Chondracanthus teedei according to the standard protocols of the Association of Official Analytical Chemists [35]. Moisture and ash content were determined at 105 °C for 24 hours and 575 °C for 6 hours, respectively; the fat content was analyzed by Soxhlet extraction with petroleum ether as a solvent and the protein content of the dried samples was examined by the Kjeldahl method, using the corresponding red algae conversion factor of 4.59 following the instructions of [36]. The total carbohydrate content (g / 100 g of body weight) was determined by difference as follows: 100- (g protein + g of fat + g of ash). Crude fiber, NDF, ADF and lignin were determined according to the Weende and Van Soest method; macroelements, microelements and amino acids were determined by mass spectrometry and HPLC. The energy (kcal / 100 g of DM) was calculated according to Regulation (EU) no. 1169/2011 [37] as follows: 4 × (g proteins + g carbohydrates) + 9 × (g fat).

Results and Discussion

Due to the difficulty of finding red algae in the distribution area of the Ionian coasts of eastern Sicily, no data on the chemical composition of the macroalga Chondracanthus teedei, called "Màuru", is found in the bibliography. The analyzes carried out on the dried samples revealed an overall chemical composition on average similar to other red macroalgae. In particular, the percentage composition of the dry substance sees the carbohydrate component prevail (39.46%), represented by 3.19% by crude fiber, followed by the protein component (38.3%), only slightly lower, and by the ashes (20.68%); lipids are not very present (1.36%). Bastos et al. [38], finds on Chondracanthus tedeei native to Brazil a decidedly lower protein content (14.66%), a slightly higher ash content (28.68%) and a similar fiber and lipid content, respectively equal to 2 , 21% and 1.82% (Table 1).

Table 1: Chemical composition (% DM ±standard deviation) of Chondrachantus teedei ("Màuru").

Parameters	
Moisture	80,27 ±1,5
Crude protein	38,3 ± 0,9
Crude fat	1,36±0,5
Ash	20,88±1,2
Carbohydrate total	39,46±1,00
Crude fibre	3,19±0,2
ADF	10,9±0,5
NDF	32,89±1,5
Lignin	4.08±0,2
Energy (kcal/100gDM)	323,28±26,13
Energy (Mj/Kg)	14,37±1,05

Morgan et al. [39] , analyzing the red macroalga Palmaria palmata, found very wide variations in the values relating to the various chemical constituents: from 73 to 89% of humidity and, on a dry basis, from 12 to 37% of ash, from 8 to 35 % crude protein, 38 to 74% carbohydrates and 0.2 to 3.8% lipids. They attribute some of the variations to different seasonal and nutritional conditions. Other authors also find significant seasonal variations in the chemical composition of red algae [40-42]. The amino acid content (Table 2) shows a high percentage of essential amino acids (46.6% of the total) and the profile of essential amino acids is close to that of egg; this, in accordance with what Dupin et al. and Friedman [43,44], allows us to consider the seaweed protein of good nutritional value.

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Table 2: Aminoacidic composition (g/100g total aminacids ±standard deviation) Chondrachantus teedei ("Màuru").

Parameters	
Essential amino acids	
Ile	3,5±1,05
Leu	6,9±2.3
Lys	3,4±1,2
Met	2,9±0,98
Met+Cys	2,8±0,64
Phe	4,8±1,03
Ute Tyr	3,6±1,05
Phe+Tyr	8,4±2,5
Thr	2,9±0,72
Val	7,4±2,8
Non essential amino acids	
Hys	0,7±0.1
Asp	13,9±3,5
Glu	8,7±3,02
hPro	2,5±0,89
Pro	2,3±0,7
Ser	5,8±2,4
Gly	9,4±5,3
Ala	5,5±1,2
Arg	4,5±1,5

Table 3: Mineral composition (mg/kg±standard deviation) Chondrachantus teedei ("Màuru").

Parameters	
Sodium	32030±1456
Potassium	31890±989
Magnesium	6759±1050
Calcium	4630±170
Phosphorum	1950±98
Iodine	1305±85
Iron	140±22
Zinc	110±12,0
Copper	3.56±0,13

Among the essential amino acids, the most represented were valine (7.4%), leucine (6.9%) and phenylalanine (4.8%). Among the non-essentials, aspartic acid (13.9%), glycine (9.4%) and glutamic acid (8.7%). Some authors note seasonal variations in the amino acid content, probably due to variations in environmental conditions such as the intensity of sunlight and the amount of nitrogen [45]. Among the macroelements potassium and sodium abound with values of 32030 and 31890 mg / kh DM; their ratio of 1 makes this alga suitable for consumers with high blood pressure problems [46] (Table 3).

Among the microelements, iodine is the most represented (1305 mg / kg DM), but, unlike sodium and potassium, the abundance of iodine could create dietary problems to have goitrogen effects. Iron, zinc and copper show levels similar to those found by other authors, with values of 140, 110 and 3.56 respectively (Table 3), as found in various marine algae [47,48]. Despite this, it is known that various factors, including the species they belong to and the geographical area of diffusion, can greatly influence the mineral and vitamin content of the [49].

Conclusion

Once much appreciated by consumers of a restricted area of eastern Sicily, Chondrachantus teedei, known by the dialectal name "Màuru", is now hardly available due to an ever smaller presence along the coasts of the distribution range, mainly due to changes undergone over the years by the chosen environment, probably due to various forms of pollution. This greatly limited the investigation possibilities of this research, the results of which concerned only some parameters of the chemical composition of the alga. Like red algae of the same species and of other species, Chondrachantus teedei has a composition in macronutrients characterized, on average, by a good level of total carbohydrates and protein and a high ash content; in particular, the protein is of good nutritional value due to its high content of essential amino acids; the ashes have a balanced ratio (equal to 1) between the most represented macroelements, ie sodium and potassium, and high quantities of iodine, between the microelements. The restoration of the good conditions of the natural habitat of Chondrachantus teedei could allow a greater presence of the alga in the distribution area and create the conditions for further desirable more in-depth investigations on the species. These investigations could concern: 1) the acidic characterization of the lipid component; 2) the presence of bioactive compounds; 3) the presence of heavy metals; 4) the detection of seasonal and / or environmental variations on nutritional characteristics.

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