

Pando Zuñiga, E. J., Herrera Mascorro, O. J., Rascón Chacón, W., y Sotelo Meraz, J. C. (2025). Spirulina algae in patients with obesity. En G. Mercado Mercado y M Del R. Moyeton Hernández (Coords). *Nutrition: Challenges, Opportunities, and Essential Strategies in the Prevention and Management of Chronic Diseases*. (pp. 139-151). Religación Press. <http://doi.org/10.46652/religacionpress.280.c477>



Chapter 9

Spirulina algae in patients with obesity

Edgar Johan Pando Zuñiga, Oliver Jesús Herrera Mascorro, Wilber Rascón Chacón, Juan Carlos Sotelo Meraz

Abstract

Spirulina is a microalgae recognized for its rich nutritional composition that makes it a valuable food and therapeutic agent. The chapter highlights the nutritional characteristics (proteins, essential fatty acids, vitamins, minerals and the pigments phycocyanin, polysaccharides and carotenoids), the various biological activities, such as antioxidant, anti-inflammatory, immunomodulatory, antiviral, anticancer, antidiabetic and lipid-lowering effects and the potential a promising candidate for preventing chronic diseases, such as obesity. In addition, this food has been gaining interest for implementation in the industrial food sector.

Keywords: Spirulina; obesity; nutrition; nutritional composition; nutrition.

Introduction

Spirulina has existed for more than 3.5 billion years as a prokaryotic cyanobacterium, and is currently considered the food of the future, thanks to its great nutritional and antioxidant contribution (Stunda-Zujeva et al., 2023). This alga belongs to the *Arthrospira* family, used for nutritional and pharmacological purposes. Studies have proven its effectiveness in the treatment of different types of diseases, including obesity (Malpartida et al., 2022). The objective of this chapter is to know how good it is to take, eat spirulina seaweed in its different presentations, for patients with obesity, it will be about looking for the doses that the patient should ingest so that it can take effect, as well as if consuming large quantities, can affect the patient to develop some extra disease, or if it simply helps the patient to lose weight, with exercise aids, good nutrition and a good administration of spirulina seaweed.

Arthrospira (Spirulina)

Arthrospira sp, commercially known as spirulina, is a blue-green microalgae (due to its content of carotenoids, xanthophyll, phycocyanin and chlorophyll) belonging to the cyanobacteria, considered a photosynthetic microorganism that has the form of cylindrical filaments arranged in noramified open helical trichomes with 20 to 100 µm in diameter (Figure 1). Its cells are surrounded by a mucilaginous film of mucopolysaccharides without a defined nucleus, since nucleic acids and other nuclear components are randomly distributed throughout the cell mass. Cyanobacteria are composed of cells measuring 1 to 3 µm in the smallest species and 3 to 12 µm for the largest or take a straight shape in artificial cultures (Vonshak, 1997).

The existence of spirulina can be calculated between 3.1 and 3.5 billion years ago, so it is located at the absolute base of the food chains that were built from it. In pre-Hispanic times it was consumed and known as tecuitlatl in Mexico, while in Africa, in the native tribes of Lake Chad it was known as dihé (Muñoz Hernández, 2019). Its taxonomic composition can be seen in Table 1.

Table 1. Taxonomic composition of *Arthrospira* sp.

Kingdom	Bacteria
Phylum	Cyanobacteria
Class	Cyanophyceae
Subclass	Oscillatoriophyceae

Kingdom	Bacteria
Family	Phormidiaceae
Genero	Arthrospira
Especie	Platensis

Source: own elaboration

Most species of the genus *Arthrospira* are found in alkaline waters, since they tend to grow abundantly in this type of habitat; while others are found in fresh water for HCO_3^- , Na^+ and K^+ supplements and in warm and highly alkaline waters of Asia, Africa, North and South America for reproduction. They are easy to cultivate since they can grow anywhere, as long as they have access to sunlight and essential nutrients, although their growth rate also depends on the availability of an addition of certain specific compounds. Their metabolism can be autotrophic, heterotrophic, mixotrophic and photoheterotrophic (Belay, Kato, and Ota, 1996). It is necessary to name the best known species of the genus *Arthrospira* as shown in Table 2.

Table 2. Species of *Arthrospir*.

Species	Origin place
Arthrospira platensis	Montevideo, Uruguay, standing water Arthrospira spirulinoides Lahore, Pakistan, stagnant rain water
Arthrospira fusiformis	Siberian steppe, Russia, Tunatan Lake
Arthrospira gomontiana	North America, stagnant water Arthrospira indica Madurai, India, natural pond
Arthrospira jenneri	Europe, stagnant water Arthrospira khannae Rangoon, Myan- mar, natural pond
Arthrospira massartii	Luxembourg, spring water
Arthrospira máxima	Oakland, California, salt pond

Source: own elaboration

Nutritional composition

In its proximal composition stands out its protein percentage between 65–75 % approximately, it contains essential amino acids that are indispensable for a healthy diet, for human beings (Hoseini, Khosravi-Darani, Mozafari, 2013). It contains between 60-70 % of proteins distributed by essential amino acids (leucine 8.7%, valine 6.5%, isoleucine 5.6%, threonine 5.2%, lysine 4.7%, phenylalanine 4.5%, methionine 2.3% and tryptophan 1.5%) and it can be said that spirulina is

an ideal nutritional supplement, together with the presence of polyunsaturated acids (5-10%) (Hoseini, Khosravi-Darani, Mozafari, 2013). Gutiérrez-Salmeán Fabila-Castillo and Chamorro-Cevallos (2015) reports that spirulina contains between 13–16.5% carbohydrates; 0.1-0.9% dietary fiber, as well as a high content of vitamins, minerals, antioxidants and phytonutrients (Stunda-Zujeva, Berele, Lece, Škesters, 2023). It also contains three extremely important pigments: phycocyanin (blue), chlorophyll (green) and carotenoids (red-orange) (Table 3). Therefore, spirulina is classified as a highly nutritious food because of its contribution of macro and micronutrients (Rodríguez, 2021), which are described in Table 3 below.

Table 3. Nutritional composition of spirulina algae.

Composition	Content (100 g)	Composition	Content (100 g)
Macronutrients		Vitamins (mg)	
Calories (Kcal)	373	Vitamin A	352000
Total fat ¹ (g)	4.3	Vitamin K	1090
Saturated	1.95	Tiamin	0.5
Polyunsaturated	1.93	Riboflavin	4.53
Monounsaturated	0.26		14.9
Cholesterol (mg)	0.1	Vitamin B6	0.96
Total carbohydrates (g)	17.8	Vitamin B12	162
Dietary fiber (g)	7.7	Minerals (mg)	
Lactose (g)	0.1	Calcium	468
Protein (g)	63	Iron	87.4
Essential amino acids (mg)		Phosphorus	961
Histidine	1000	Iodine	142
Isoleucine	3500	Magnesium	319
Leucine	5380	Zinc	1.45
Lisine	2960	Selenium	25.5
Methionine	1170	Copper	0.47
Phenylalanine	2750	Manganese	3.26
Threonine	2860	Chromium	400
Tryptophan	1090	Potassium	1660
Valine	3940	Sodium	641
		Phytonutrients	

Composition	Content (100 g)	Composition	Content (100 g)
Non-essential amino acids (mg)		Phycocyanin (%)	17.2
Alanine	4590	Chlorophyll (%)	1.2
Arginine	4310	SOD (IU)	531000
Aspartic acid	5990	gamma linoleic acid (mg)	1080
Cystine	590	Total carotenoids (mg)	504
Glutamic acid	9130	-carotene	211
Glycine	3130	Zeaxanthin	101
Proline	2380		
Serine	2760		
Tyrosine	2500		

Source: SOD Super oxide dismutase Giraldo y Siller (2016).

Spirulina has aromatic rings containing substituents which allow it to act as electron donors or free radical scavenger (Skerget et al., 2005; Ibañez et al. 2012), and has a chemical structure suitable for antioxidant action. Its main active part is phycocyanin, which has a sequestering capacity of alkoxyl, hydroxyl and peroxy radicals, is formed by two polypeptide chains α and β , which are linked by non-covalent interactions and has three chromophores phycocyanobilin, which is a linear tetrapyrrole which sequesters free radicals by thioether bonding (Domínguez et al., 2018).

Beneficial contributions to health

This cyanobacterium has immunological, antioxidant and antiviral properties, it is an anti-aging supplement, effective against anemia, demineralization and exhaustion, it favors physical and energetic recovery and detoxification of the organism (Wu et al., 2005). Phycocyanin stimulates lymphocyte activity, in the prevention of cancer cell growth. It has also been reported to have favorable effects on the inhibition of HIV-1 replication, antiseptic and detoxifying, as well as acting synergistically in iron uptake and assimilation (Ferruzzi and Blakeslee, 2007). Lacking cell membranes, its digestibility reaches 88-92%, which increases the bioavailability of its polyunsaturated acids, proteins and phytonutrients, providing benefits to the organism such as blood pressure regulation, cholesterol synthesis and cell division (Ibañez et al. 2012).

Spirulina has been studied for its possible impact on obesity due to its high content of dietary fiber and bioactive compounds (Marjanović et al., 2024). Despite its low caloric intake and its ability to induce satiety, experimental studies have shown mixed results in weight reduction. In a study with Wistar rats, no significant changes in body weight were observed after the administration of spirulina, although alterations were recorded in some biochemical markers such as increased urea and triglycerides. However, its richness in nutrients has been valued to improve energy metabolism and modulate inflammatory processes related to obesity (Hoseini et al., 2013). In addition, spirulina has been promoted for its antioxidant properties, its potential to strengthen the immune system and its use in the control of metabolic diseases. Although its role in weight loss is still debated, its use as a supplement in the diet of people with obesity could provide important nutritional benefits (Guillen-Martín del Campo et al., 2019).

Nutritional composition of spirulina and its relevance in obesity

Spirulina algae has a wide range of beneficial properties which, consequently, contains a significant amount of micronutrients (potassium, magnesium, calcium, zinc, manganese, selenium, iron and phosphorus), in addition to the contribution of macronutrients such as carbohydrates, lipids and proteins. Nutritionally, spirulina algae is an efficient tool to counteract oxidation and care against oxidizing agents, widely used in impersonation for people with pathologies derived from free radicals in the body. A comparison is also made between the differences between the nutritional information of the supplement today and that of research or publications in previous years. Scientific evidence also proves its efficacy as a means of supplementation rich in B vitamins, where we can specifically in vitamins B1, B2, and B3, which play a relevant role in the synthesis of plasma proteins and thus making a complement to the reinforcement of the immune system (Malpartida et al., 2022).

It is because of all its properties and relationships with patients with obesity that makes it an excellent option to supplement diets. This seaweed has a high content of essential amino acids and nutrients that can help improve metabolism, especially that of lipids and carbohydrates. Its ability to promote satiety is one of its most prominent benefits, as its high protein content helps reduce caloric intake, which is useful for weight management. In addition, its antioxidant properties help combat oxidative stress, which is related to obesity and its complications. Spirulina has also been shown to have positive effects on lipid regulation, reducing fat levels in the body. Due to its nutrient-rich composition, this microalga can be a valuable supplement in obesity prevention and treatment strategies (Malpartida et al., 2022).

Spirulina in weight loss

Newly, it has been shown that spirulina algae has been used for weight reduction, as it is known that with only 36 g of this algae all the essential amino acids are obtained, as well as other compounds such as fiber and flavonoids, which could help treat obesity and overweight. The aim of the study was to analyze whether the administration of spirulina contributes to weight loss in Wistar rats and to observe its impact on several biochemical markers related to metabolism, such as lipid profile, urea and creatinine. An experimental study was carried out with 10 Wistar rats. Four rats were treated with 5.8 mg of spirulina dissolved in 1 ml of water, administered by orogastric tube for 8 weeks, while the control group, composed of 6 rats of the same species and initial weight, only received 1 mL of water. No significant differences in weight were observed between the experimental rats and those in the control group. Regarding biochemical markers, a significant increase in urea, total cholesterol and triglyceride levels was detected in the experimental rats compared to the control group. These results suggest that spirulina could be useful for weight control and in situations of malnutrition (Guillen-Martin del Campo et al., 2025).

Due to the concentrated nutritional value of spirulina it is also emerging as a supplement and just remember that this has to be accompanied by an exercise regime and good nutrition, since it will be useless to consume it if we do not manage to control that, spirulina will help us to control the binge eating that the individual is given on the days that this superfood is used and it is also voluntary to take it during the weight loss process (Innecco, 2021). Just like taking one gram of spirulina already demonstrated in human patients, it has been shown that with just one gram a day, it can help in weight loss, it can also be given for 12 weeks, since it will also help modulate body weight, as well as appetite, with these studies that could be carried out, it can be confirmed that there is a great efficacy of this supplement called spirulina, for the control and prevention of obesity and obesity-related disorders (Zeinalian et al., 2017).

Spirulina in lipid profiles and cardiovascular health

It has been shown that spirulina is very effective in lowering cholesterol and triglyceride levels in the blood. As mentioned, it has been shown that its regular consumption can significantly reduce LDL cholesterol and triglycerides, thanks to its high content of antioxidants and essential fatty acids, which help improve lipid metabolism. It should be remembered that spirulina can be consumed in different

formats such as powder, tablets or capsules, depending on the preference of each individual and their lifestyle, although spirulina powder can be recommended as it is more versatile and can be incorporated faster into the diet (Serban, 2016).

Cardiovascular disease is one of the leading causes of death, and high cholesterol and triglyceride problems are risk factors. In addition, oxidative stress, which occurs when there is an excess of free radicals in the body, also contributes to these diseases. To reduce these risks, the consumption of antioxidants is recommended. Spirulina, an algae rich in nutrients and antioxidants, has shown benefits for cardiovascular health. It helps reduce LDL cholesterol and triglyceride levels, improving lipid profiles. It also has antioxidant properties that protect the body from damage caused by free radicals. In summary, spirulina may be helpful in maintaining heart health and reducing cardiovascular risk factors (Hernández-Lepe et al., 2015).

It contains polyunsaturated fatty acids such as omega-3 and omega-6, which are good for the heart, and high-quality proteins with all essential amino acids. It is also rich in B vitamins, beta-carotene, minerals such as iron, zinc, magnesium, and other important nutrients such as fiber and antioxidants that have anti-inflammatory and cell-protective properties. The consumption of *Spirulina platensis* is linked to the reduction of obesity and associated comorbidities, such as diabetes, dyslipidemias (altered levels of lipids in the blood), hypertension, cardiovascular disease, and certain types of cancer. In addition, this seaweed can contribute to improving nutrition in overweight or obese people, helping to avoid nutritional deficiencies that sometimes occur due to inadequate or restrictive diets. Its satiating effect, together with its high nutrient content, makes it a good supplement for those looking to control their weight or improve their cardiovascular health without compromising their nutritional intake (Hernández, 2021).

Spirulina can be a useful supplement for people who are following a weight loss diet, as it helps avoid protein, vitamin, and mineral deficiencies that can occur on a restrictive diet. Despite being low in calories (3 g of spirulina contains only 11.28 Kcal), it offers several health benefits. It helps reduce visceral fat by decreasing macrophages in fat tissue, prevents excessive fat accumulation in the liver, improves insulin sensitivity, and reduces insulin levels in the blood. One of the important effects of spirulina is its ability to reduce appetite. This is because it contains mucilage (polysaccharides such as carrageenan), which upon entering the stomach expand by absorbing water, creating a feeling of fullness and reducing the desire to eat. In addition, spirulina contains phycocyanin, which helps remove cholesterol and bile acids from the body, reducing the absorption of fats in the intestine. This, along with niacin and other compounds such as the glycolipid H-b12, contributes to lowering triglyceride levels, which can help prevent cholesterol problems and obesity-associated diseases, such as dyslipidemia (Martínez et al., 2024).

Recommended dosage of spirulina in people with obesity

An appropriate dose for each individual is 3 to 5 g of spirulina daily, according to the weight of each individual, it does not specify that, if they are obese or not, the individual has to take more grams or less. Which is equivalent to a tablespoon of spirulina powder or 6 to 10 tablets of 500 mg, these doses should be consumed 30 minutes before each meal in order to reduce appetite. It is also advisable to always go to a doctor to allow us to use this supplement or not (Martinez et al., 2024).

Considerations for the consumption or use of spirulina

It should be taken into consideration that spirulina is more of a superfood, so it cannot be considered a medicine, people who consume it have to be very clear about that, but you can get some medicines because if some have been made with this algae, if people consume the recommended doses, there will be no need to be afraid, but on the contrary if the person is not so used to this superfood, they may present some diseases or negative effects such as dermis rash, thirst, constipation or milder gastric discomfort (Moyano Calero & Ochoa Galarza, 2022).

Conclusion

Spirulina's chemical composition and diverse bioactivities position it as an important and ideal candidate to be considered for nutritional supplementation and therapeutic use by individuals. Spirulina stands out for its high protein content, micronutrients and the presence of bioactive compounds. Its antioxidant, anti-inflammatory, anti-diabetic and lipid-lowering properties, among others, offer significant potential for the prevention of chronic diseases.

Acknowledgements

This chapter has been supported by the Fund of Centro de Estudios Universitarios Vizcaya de las Americas within the framework of the celebration of the day of the nutritionist in Mexico and with the purpose of increasing the academic and scientific capacity of Universidad Vizcaya de las Americas.

Reference

- Belay, A., Kato, T., & Ota, Y. (1996). Spirulina (*Arthrospira*): potential application as an animal feed supplement. *Journal of Applied and Phycology*, 8, 303-311.
- Ferruzzi, M.G., & Blakeslee, J., (2007). Digestion, absorption, and cancer preventative activity of dietary chlorophyll derivatives. *Nutrition Research*, 27, 1-12.
- Giraldo Chermanz, A., & Siller Lopez, F. (2016). Efectos de la suplementacion con espirulina deportistas sanos. *Universidad Libre Colombia*, 27.
- Guillen-Martin del Campo, J. A., Calvillo- Femat, A., Mosqueda- Esparza, J. I., Rodriguez- Hernandez, A. I., & Jaramillo- Gonzalez, F. (2025). Espirulina un suplemento alimenticio como posible alternativa en el control de peso. Un estudio con ratas Wistar. *Journal of the Selva Andina Research Society*, 11(1), 49-56.
- Gutiérrez-Salmeán G, Fabila-Castillo L, Chamorro-Cevallos G. (2015). Nutritional and Toxicological aspects of spirulina (*arthrospira*). *Nutrición Hospitalaria*, 32(1), 34-40.
- Hernández Rodríguez, J. N. O. (2021). Spirulina platensis en el tratamiento de la obesidad y de algunas. *Revista Cubana de Medicina General Integral*, 37(3), 1-22.
- Hernández-Lepe, M., Wall-Medrano, A., Juárez-Oropeza, M., Ramos-Jiménez, A., & Hernández-Torres, R. (2015). Spirulina y su efecto hipolipemiente y antioxidante en humanos: una revisión sistemática. *Nutricion Hospitalaria*, 32(2), 494-500.
- Hoseini, S. M., Khosravi-Darani, K., & Mozafari, M. R. (2013). Nutritional and medical applications of spirulina microalgae. *Mini Reviews of Medicine and Chemistry*, 13, 1231-1237.
- Ibañez, E., Herrero, M., Mendiola, J. A., & Castro-Puyana, M. (2012). *Extraction and characterization of bioactive compounds with health benefits from marine resources: macro and micro algae, cyanobacteria, and invertebrates*, in *Marine Bioactive Compounds*. Springer.
- Martínez Rendón, N., López Riveroll, A. S., & Ariza Ortega, J. A. (2024). Efecto del consumo del alga espirulina (*Arthrospira platensis*) sobre marcadores y biomarcadores de sobrepeso y obesidad. *Educación Y Salud Boletín Científico Instituto De Ciencias De La Salud Universidad Autónoma Del Estado De Hidalgo*, 12(24), 7-15. <https://doi.org/10.29057/icsa.v12i24.11919>
- Marjanović, B., Benković, M., Jurina, T., Sokač Cvetnić, T., Valinger, D., Gajdoš Kljusurić, J., & Jurinjak Tušek, A. (2024). Bioactive Compounds from *Spirulina* spp.—Nutritional Value, Extraction, and Application in Food Industry. *Separations*, 11(9), 257. <https://doi.org/10.3390/separations11090257>

- Malpartida Y., R. J., Aldana F. L., Sánchez S. K., Gómez H., L., & Lobo P. J. (2022). Valor nutricional y compuestos bioactivos de la espirulina. *Ecuadorian Science Journal*, 6(1), 1-10.
- Moyano Calero, W., & Ochoa Galarza, K. (2022). Aplicaciones de la espirulina-planta marina: revision panoramica. *Salud, Ciencia y Tecnologia*, 2, 174.
- Muñoz Hernández, L. (2019). El impacto de la Espirulina en la alimentación humana. *Ingeniería al día*, 7, 28-30. http://revistaingenieriaaldia.ucentral.cl/rev_7/art_4.pdf
- Ozturk, S., & Irkin, L. C. (2024). Efecto protector espirulina en el ovario de ratas frente a la toxicidad de la doxorubicina. *Revista Científica de la Facultad de de Veterinaria*, 1.
- Serban M. C. (2016). La espirulina es eficaz contra el colesterol y los triglicéridos. *Salud, Nutricion y Bienestar*. <https://n9.cl/b69dy>
- Stunda-Zujeva A, Berele M, Lece A, Šķesters A. (2023). Comparison of antioxidant activity in various spirulina containing products and factors affecting it. *Science Reports*, 13(1), 4529.
- Vonshak, A. (1997). *Spirulina platensis arthrospira: physiology, cell-biology and biotechnology*. CRC Press.
- Wu, L.-C., Ho, J. A., Shieh, M. C., & Lu, I. W. (2005). Antioxidant and antiproliferative activities of Spirulina and Chlorella water extracts. *Journal of Agriculture and Food Chemistry*, 53.
- Zeinalian, R., Abbasalizad Farhangi, M., Saghafi- Asl, M., & Shariat, A. (2017). Los efectos de *Spirulina platensis* sobre los índices antropométricos, el apetito, el perfil lipídico y el factor de crecimiento endotelial vascular sérico (VEGF) en individuos obesos: un ensayo aleatorizado doble ciego controlado con placebo. NIH.

Algas espirulina en pacientes con obesidad

Algas spirulina em pacientes com obesidade

Edgar Johan Pando Zuñiga

Universidad Vizcaya de las Américas | Chihuahua | México

<https://orcid.org/0009-0002-9498-2756>

edgarjohanpandozuniga@gmail.com

Eighth semester nutrition student in the city of Chihuahua, Chihuahua.

Oliver Jesús Herrera Mascorro

Universidad Vizcaya de las Américas | Chihuahua | México

<https://orcid.org/0009-0009-2920-1272>

herreraoliver849@gmail.com

Nutrition student in her eighth semester at the Chihuahua campus.

Wilber Rascón Chacón

Universidad Vizcaya de las Américas | Chihuahua | México

<https://orcid.org/0009-0003-5302-5746>

wilberboxing99@gmail.com

Nutrition student in her eighth semester at the Chihuahua City campus in Chihuahua, Chihuahua.

Juan Carlos Sotelo Meraz

Universidad Vizcaya de las Américas | Chihuahua | México

<https://orcid.org/0009-0001-5610-9828>

juancarlosotelomeraz@gmail.com

Eighth semester student of the nutrition career at the Chihuahua campus, Chihuahua, Chihuahua.

Resumen

La espirulina es una microalga reconocida por su rica composición nutricional que la convierten en un valioso alimento y agente terapéutico. El capítulo subraya las características nutricionales (proteínas, ácidos grasos esenciales, vitaminas, minerales y los pigmentos ficocianina, los polisacáridos y los carotenoides), las diversas actividades biológicas, como efectos antioxidantes, antiinflamatorios, inmunomoduladores, antivirales, anticancerígenos, antidiabéticos y reductores de lípidos y el potencial un candidato prometedor para prevenir enfermedades crónicas, como la obesidad. Además, este alimento ha ido aumentando el interés para implementarse en el sector industrial de los alimentos.

Palabras clave: Espirulina; obesidad; composición nutrimental; nutrición

Resumo

A espirulina é uma microalga reconhecida por sua rica composição nutricional, o que a torna um valioso alimento e agente terapêutico. O capítulo destaca as características nutricionais (proteínas, ácidos graxos essenciais, vitaminas, minerais e os pigmentos ficocianina, polissacarídeos e carotenoides), as diversas atividades biológicas, como efeitos antioxidantes, anti-inflamatórios, imunomoduladores, antivirais,

anticancerígenos, antidiabéticos e redutores de lipídios, e o potencial como candidata promissora para a prevenção de doenças crônicas, como a obesidade. Além disso, esse alimento vem ganhando interesse para ser implementado no setor industrial de alimentos.

Palavras-chave: Spirulina; obesidade; nutrição; composição nutricional; nutrição