

Phytochemical and pharmacological evaluation of *Sargassum polycystum*

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ABSTRACT

Sargassum polycystum, a brown macroalga, has garnered significant attention in recent years due to its diverse biological properties. This review provides a comprehensive overview of its botanical characteristics, distribution, and ecological significance. *Sargassum polycystum* is rich in bioactive compounds, including polysaccharides, polyphenols, pigments, and essential fatty acids. The elucidation of these constituents opens avenues for various applications in pharmaceuticals, nutraceuticals, and cosmeceuticals. Numerous studies have highlighted the pharmacological potential of *Sargassum polycystum*. Its extracts exhibit anti-inflammatory, antioxidant, antidiabetic, and antimicrobial activities. Moreover, the alga shows promise in the treatment of various diseases, making it a valuable resource for drug discovery. Beyond its pharmacological applications, *Sargassum polycystum* has ecological importance. It serves as a habitat for diverse marine life, contributing to the overall health of coastal ecosystems. *Sargassum polycystum* emerges as a multifaceted resource with promising applications in medicine, industry, and environmental conservation. Further research is warranted to unlock its full potential and address challenges associated with sustainable harvesting and utilization.

KEYWORDS: *Sargassum polycystum*, seaweed, phytochemical composition, pharmacological activities.

I. INTRODUCTION

Seaweeds are marine macro algae, they are non-flowering plant means which lack flowers, true

shoots, leaf, stem and root system. Seaweeds are usually grown vertically away from substratum which makes them closure to light. Environmental factors like light, temperature, salinity, water motion, nutrient availability are related to growth of a seaweed. Seaweeds are classified into three groups namely green, brown and red based on their pigments.[1] Seaweeds are known to contain nutrients that are essential for human nutrition, making them edible and potential resources for many bioactive substances. One type of brown marine macroalgae with a variety of uses is *Sargassum polycystum*. Antibiotic, antioxidant, antibacterial, anticoagulant, and anti-ulcerative properties. Coastal societies have been consuming seaweeds since prehistoric times because the edible species are known to provide considerable amounts of vital nutrients for human nutrition, such as protein, lipids, polysaccharides, vitamins, and minerals, sargassum has the potential to be mined for bioactive materials, such as prebiotics for fish farming.[2]

Sargassum polycystum is a brown seaweed commonly found in tropical and subtropical coastal regions. Because of rich bioactive constituents, this seaweed has drawn attention for its potential medicinal properties. Researchers are exploring its use in various fields, including pharmaceuticals and nutraceuticals. *S. polycystum* has a cylindrical talus with tiny thorns, holdfast forms a small disk, and a stolon root that spreads outward on top of the disc. short, branching stems with bubbles in them which are typically found in groups and can grow up to 7 meters in length. The talus is typically brown in

colour. In Indonesia, the *S. polycystum* may grow in a wide range of environments. [3]

Substances found in both free and bound forms from *S. polycystum*, acquired by various extraction solvents and hydrolysis techniques, and detected by high-performance liquid chromatography-diode array detection (HPLC-DAD) and ultra-high-performance liquid chromatography-mass spectrometry (UHPLC-MS). *Sargassum polycystum* can be extracted methanol, 70% methanol, 50% methanol, ethanol, 70% ethanol, 50% ethanol, acetone, 70% acetone, 50% acetone, or ethyl acetate. Researchers use various methods like solvent extraction, steam distillation, or even supercritical fluid extraction. Solvent extraction involves using organic solvents to dissolve the bioactive compounds from the seaweed. This method is versatile but requires careful consideration of solvent choice to avoid impurities. Steam distillation is more commonly used for extracting essential oils. It's a gentler method, preserving delicate compounds, but it may not be suitable for all types of bioactive compounds in *Sargassum polycystum*. [4].

Seaweeds, including *Sargassum* species, have been used in traditional medicine in various coastal communities for centuries. People recognized their potential health benefits, although the specific bioactive compounds were not identified. In the mid to late 20th century, research intensified on marine organisms for potential pharmaceutical applications. *Sargassum polycystum* caught the attention of researchers due to its abundance and diverse chemical composition. [5]

Sargassum polycystum generate metabolites with a variety of medicinal properties, including terpenoids, polysaccharides, polyphenols,

plastoquinone, sargaquinic acids, sargachromenol, steroids, and glycerides. It has been dubbed the therapeutic food of the twenty-first century due to its many pharmacological qualities, and studies are being done on it to uncover its other pharmacological qualities. *Sargassum* yields the metabolites fucoidans, phlorotannin and meroterpenoids. It appears that the role of iodine in *sargassum* in the treatment of disorders connected to the thyroid has been overestimated. In China and several other Asian countries, *Sargassum polycystum* are used as fertilizer and animal feed. In Japan, where the sensitive sections of the plant are consumed raw as salad or cooked with coconut milk, *sargassum* makes up over 10% of the typical diet. [6]

In the 2000s, studies began highlighting the antidiabetic properties of *Sargassum polycystum*. Researchers identified compounds that could potentially regulate blood sugar levels, paving the way for exploring its use in diabetes management. Subsequent research uncovered the antimicrobial and anti-inflammatory properties of the *Sargassum polycystum*. These findings expanded its potential applications in treating infections, inflammatory conditions, and even certain skin disorders. In more recent years, investigations into the anticancer potential of *Sargassum polycystum* gained momentum. Researchers identified compounds with inhibitory effects on cancer cell growth, opening up possibilities for cancer treatment and prevention. The cardioprotective effects of the seaweed, including its impact on cholesterol levels and heart function, have been a focus of attention. This has implications for developing medications to support cardiovascular health. [7]

TAXONOMICAL CLASSIFICATION

Kingdom	:Chromista
Phylum	:Ochrophyta
Class	:Phaeophyceae
Subclass	:Fucophycidae
Order	:Fucales
Family	: <i>Sargassaceae</i>
Genus	: <i>Sargassum</i>
Species	: <i>Sargassum polycystum</i>

SYNONYMS

Sargassum myriocystum
Sargassum elegans
Sargassum brevifolium
Sargassum opacum

COMMON NAMES

Sargassum weed
Agar-agar koepan

DISTRIBUTION

Atlantic Islands: Canary Islands
Africa: Kenya, Madagascar, Mozambique, Tanzania
Indian Ocean Islands: Andaman Islands, Mascarene,
Seychelles.



Figure1:*Sargassum polycystum*

BOTANICAL DESCRIPTION

Sargassum polycystum is a species of marine Phaeophyta (brown algae), with a body differentiated into organs like axis, twig, leaf, pneumatocyst, receptacle, etc. The branch surface is full stickshaped tubercles. The leaf is small in the shape. The pneumatocyst is Ball shaped diameter of

around 0.1-0.2 cm. The receptacle is columnar or flat with tubercles on the surface. The body can be as tall as 90 cm. Thalli large, dark brown to yellowish brown, attached to rocks by a coarse branching holdfast; stem short cylindrical.

Mature thalli with fewer and smaller oblanceolate leaves, 7 to 15 mm long and 1.5 to 4 mm wide,

with coarsely dentate or serrated margins; midrib prominent up to near the apex. Cryptostomata scattered on the surface of leaves.[8]

PHYTOCHEMICAL COMPOSITION OF *Sargassum polycystum*

The phytochemistry of *Sargassum polycystum* is quite diverse, as this seaweed contains a variety of bioactive compounds that contribute to its medicinal properties. *Sargassum polycystum* are rich sources of proteins, lipids, polysaccharides, minerals, enzymes, anti-oxidants, phytonutrients and vitamins (A, E, C and Niacin) essential for human nutrition that has been reported in various literatures. The nutrient composition of seaweeds is varied based on their ecological and physiological conditions. Moreover, *S. polycystum* contains many essential elements like potassium, magnesium, iron and zinc. Chemical composition includes carbohydrates, proteins, lipids, vitamins and minerals. Commonly contain polysaccharides like alginates, fucoidans and laminarans [9]. Here are some key components identified in the phytochemical profile:

Alkaloids: Certain alkaloids have been detected in *Sargassum polycystum*. Alkaloids often exhibit diverse pharmacological activities, and their presence in the seaweed adds to its bioactive compound repertoire. Alkaloids are commonly found to have antimicrobial properties against both Gram-positive and Gram-negative bacteria. The results for phytochemical screening of *S. polycystum* revealed the alkaloids presence in the methanolic extract of *S. polycystum*. [10]

Phenolic compounds: *Sargassum polycystum* is rich in phenolic compounds, including phenolic acids and flavonoids. These compounds contribute to the antioxidant and anti-inflammatory properties of the seaweed. The majority of phenolic compounds, known as flavonoids, are known to have a wide range of biological and chemical functions, including the ability to scavenge free radicals and act as antioxidants. Proanthocyanidins, anthocyanidins, flavanols, flavones, catechins, and iso flavonoids are examples of flavonoids. In *Sargassum polycystum*, defence mechanisms against invasive bacteria and other environmental stressors such wounds, excessive light, and ultraviolet (UV) radiation, phenolic chemicals play a significant role. Comparing co-occurring biofilms on inanimate substrata to those on thalli of several marine plants, including seaweeds, one can typically find that the former have substantially fewer macro and micro epibionts. Thus, it has been

postulated that *Sargassum polycystum* produce secondary compounds to protect themselves from bacterial fouling by preventing bacterial colonists from attaching and growing. *Sargassum polycystum* is known to contain tannins, which are polyphenolic compounds with astringent properties. Tannins are found in various parts of plants, including seaweeds, and they play a role in Défense mechanisms against herbivores and pathogens. The specific uses of tannins present in *Sargassum polycystum* can vary, and they are likely to contribute to the seaweed's overall biological activities. [11]

Saponins: Saponins are a group of chemical compounds found in various plants and marine organisms, known for their soap-like properties. In the case of *Sargassum polycystum*, research has identified the presence of saponins in this seaweed species. Saponins from *Sargassum polycystum* have been investigated for their potential biological activities and pharmacological effects. While the specific types and structures of saponins can vary. Saponins are considered a key ingredient in traditional Chinese medicine and are responsible for most of the observed biological effects. Saponins are known to produce an inhibitory effect on inflammation. There is tremendous, commercially driven promotion of saponins as dietary supplements and nutraceuticals. Saponin possesses specific physical, chemical and biological activities that make them useful as drugs. Some of these biological properties include antimicrobial, anti-inflammatory, and haemolytic effects. These observations cited on phytochemical compounds support our findings on the usefulness of seaweeds in traditional medicament. [12]

Polysaccharides: *Sargassum* species, including *polycystum*, are known for their polysaccharide content. Fucoidans, laminarans, and alginate are examples of polysaccharides found in *Sargassum polycystum*. These compounds have various biological activities, including anti-inflammatory and anticoagulant properties. Polysaccharides are mainly made up of mannose, glucose, galactose, and fucose, along with small proportions of arabinose and rhamnose. *Sargassum polycystum* is mainly composed of three polysaccharides, which are fucoidans, alginate, and laminarin. Their conformation varies depending on the species of brown algae. These variations in the content of polysaccharides are due to conditions such as population age, temperature, and geographic location, and this is reflected in their biological

activities that allow them to act as anti-inflammatory, anticoagulant, antiviral, or antioxidant agents, among others.[13]

Glycosides: Glycosides are compounds that contain a sugar molecule (glycone) attached to a non-sugar moiety (aglycone). In the case of *Sargassum polycystum*, research has identified the presence of various glycosides, contributing to the *sargassum polycystum* bioactive chemical profile. Certain glycosides have been linked to anti-inflammatory properties. In *Sargassum polycystum*, these compounds may play a role in managing inflammatory conditions. Some glycosides have been associated with cardiovascular benefits. In the context of *Sargassum polycystum*, these compounds may contribute to its potential in supporting heart health.[14]

Lipids: *Sargassum polycystum* contains lipids, including fatty acids. These lipids contribute to the nutritional value of the seaweed and may have implications for human health. information on steroids specifically identified in *Sargassum polycystum* is not as extensive compared to some

other classes of compounds. However, certain studies have reported the presence of sterols, which are a type of steroids, in various *Sargassum* species, including *Sargassum polycystum*. Phytosterols, are known to have nutritional benefits. They can contribute to the overall nutritional profile of *Sargassum polycystum*. Certain sterols exhibit anti-inflammatory activities. In *Sargassum polycystum*, these compounds may play a role in managing inflammatory condition.[15]

Terpenoids: Terpenoids are a diverse group of organic compounds found in various plants, including seaweeds like *Sargassum polycystum*. While specific information about the terpenoids present in *Sargassum polycystum* obtained from scientific studies, seaweeds, in general, are known to contain a variety of terpenoids. Terpenoids can have various biological activities, including anti-inflammatory, antioxidant, antimicrobial, and anticancer properties. The specific terpenoids present in *Sargassum polycystum* would determine its potential uses.[16]

Table 1: Phytochemical analysis of *Sargassum polycystum* extracts

SL No	Metabolites	Petroleum ether	chloroform	Methanol	Acetone	Aqueous extract
1	Alkaloids	-	-	+	-	-
2	Terpenoids	-	-	+	-	-
3	Flavonoids	+	-	-	+	-
4	Saponins	-	-	+	+	-
5	Sterols	+		+	+	+

+present, -- Absent

PHARMACOLOGICAL ACTIVITIES OF *Sargassum Polycystum*

ANTIHEPATOTOXIC ACTIVITY

Research suggests that *Sargassum polycystum* may exhibit hepatoprotective properties due to its antioxidant, anti-inflammatory, and detoxifying effects. The presence of bioactive compounds such as polyphenols, flavonoids, and polysaccharides in *Sargassum polycystum* is believed to contribute to its protective effects on the liver. The effects of *Sargassum polycystum* alcohol extract on hepatic antioxidant state in rats with hepatitis induced by D-galactosamine. When *Sargassum polycystum* extract (125 mg/kg body weight) was administered for 15 days, the elevations in the level of diagnostic

marker enzyme in the plasma of the experimental rats caused by D galactosamine were significantly (P<0.05) attenuated. Additionally, by preventing the promotion of lipid peroxidation and maintaining the hepatic enzymatic and non-enzymatic antioxidant defence system at nearly normal levels, it showed antioxidant efficacy against D galactosamine-induced hepatitis. Studies have shown that extracts from *Sargassum polycystum* can reduce liver damage caused by various toxins and oxidative stress. These extracts may also help in restoring normal liver function by promoting the regeneration of liver cells.[17].

ANTIMICROBIAL ACTIVITY

The antimicrobial activity of *Sargassum polycystum* extracts has been investigated against

various pathogens, including bacteria and fungi. It has shown inhibitory effects against the growth of certain strains, indicating its potential as a natural antimicrobial agent. Phytochemicals such as tannins, polyphenols, saponins, cardiac glycosides, and quinones were found during the initial screening process. Among these bioactive compounds, three (the 1,2-benzene dicarboxylic dibutyl ester, 13, docosenamide of the ethanolic extract, and 3,5 diaminodeoxymethoxy of the methanolic extract) demonstrated the ability to react and bind with the common pathogenic bacterium, *Pseudomonas aeruginosa*, which produces exotoxin-A. The ethanolic and methanolic extracts of *S. polycystum* were found to have the capacity to suppress *Aeruginosa* growth in the *in vitro* antibacterial experiments [18]. Thus, *S. polycystum* could be used to prepare aquaculture medication. Using broth microdilution and disc diffusion, *Sargassum polycystum* was investigated. Minimum bactericidal concentration (MBC) and minimum inhibitory concentration (MIC) were used to describe the bioactivity of the seaweed extracts. The *Sargassum polycystum* extracts had a greater effect on gram-positive bacteria, particularly *B. cereus* (MIC = 0.0130 to 0.065 mg/ml). When compared to *Australis*, *Sargassum polycystum* extracts generally showed greater bacteriostatic activity against all of the examined bacterial strains. *S. polycystum* n-hexane extracts showed encouraging bacteriostatic agents against *B. cereus* (MIC = 0.065 mg/ml), with a MIC value that was less than the typical MIC of a possible antimicrobial medication (0.100 mg/ml). [19].

ANTIOXIDANT ACTIVITY

Sargassum polycystum has been found to exhibit antioxidant activity, because of the presence of bioactive compounds such as polyphenols, flavonoids, and carotenoids. These compounds are known for their ability to neutralize harmful free radicals in the body, which can contribute to oxidative stress and various diseases. Research studies have explored the antioxidant potential of *Sargassum polycystum* extracts, and the results indicate scavenging of free radicals and reduction of oxidative damage. Antioxidants play a crucial role in maintaining cellular health and protecting the body from oxidative stress-related conditions. It's worth noting that the antioxidant activity of *Sargassum polycystum* may vary depending on factors such as the extraction method, geographical location, and environmental conditions [20]. As with any research topic, it's essential to stay

updated on the latest scientific literature for the most accurate and comprehensive information. It was found that the synthesized compounds' ability to scavenge radicals against the stable free radical 2,2-diphenyl-1-picrylhydrazyl. When antioxidant chemicals, which may contribute hydrogen, react with DPPH, it becomes decreased. Its deep violet colour in methanol faded to yellow after the reduction, indicating a notable absorption drop at 517 nm. Next, 1ml of an ethanol solution containing 40 µg/ml of DPPH was mixed with 3ml of different concentrations (2,4,8,16, and 32 µg/ml) of the compounds (3a-3j) dissolved in ethanol. The absorbance was measured at 517 nm using a Shimadzu UV-Vis spectrophotometer against a blank following a 30-minute incubation time at room temperature. Using ascorbic acid as the reference material. Studies have shown that extracts from *Sargassum polycystum* can reduce oxidative damage caused by various toxins and oxidative stress. [21]

ANTIWRINKLE ACTIVITY

Sargassum polycystum have cosmetic qualities. Researchers have focused on the bifunctional and physicochemical properties of seaweed polysaccharides. The *Sargassum polycystum* were gathered from Sri Lanka and their cosmetic qualities assessed. Based on monosaccharide composition analysis and Fourier transform spectroscopy infrared (FTIR) spectroscopy, it was determined that the purified polysaccharides were rich in fucoidan and that both fucoidans had a comparatively high sulphate content. Diphenyl-1-picrylhydrazyl (DPPH) and alkyl radical scavenging activities were demonstrated by *Sargassum polycystum*. Additionally, the plant exhibited anti-inflammatory effects on lipopolysaccharide-stimulated RAW 264.7 macrophages, inhibitory qualities against collagenase and elastase, and skin-whitening effects through direct inhibition of tyrosinase and intracellular melanin synthesis, studies are shown that *Sargassum polycystum* were promising for skin care [22,23].

ANTICANCER ACTIVITY

Research on the anticancer and cytotoxic activity of *Sargassum polycystum* suggests that it may have potential in inhibiting the growth of cancer cells. The presence of bioactive compounds, such as polyphenols, fucoxanthin, and other secondary metabolites, contributes to its cytotoxic effects. Studies have shown that extracts from

Sargassum polycystum exhibit anti-proliferative effects on various cancer cell lines. These effects may involve inducing apoptosis (programmed cell death) and inhibiting the proliferation of cancer cells. Additionally, the seaweed's anti-inflammatory and antioxidant properties may contribute to its potential anticancer activity. However, it's important to note that while there is promising evidence, further research is needed to fully understand the mechanisms involved and to explore the potential therapeutic applications of *Sargassum polycystum* in cancer treatment. The anti-cancer effect of *Sargassum polycystum* against the reproduction of malignant cells was reasonable. The extract exhibited maximum potency on K562 and Daudi cell lines at doses of 400 µg/ml and 500 µg/ml, respectively. In vitro and in vivo, *Sargassum polycystum* polysaccharides shown strong anti-tumour efficacy and enhanced immune function in tumor-bearing mice. Significant in vitro anti-tumor activity was also demonstrated by two polysaccharide fractions from *Sargassum polycystum*, namely SP-3-1 and SP-3-2, against HepG2 cells, A549 cells, and MGC-803 cells. The hexane fraction of *Sargassum polycystum* methanol extract exhibited cytotoxicity against Caco-2 and T47D cells in vitro and raised the proportion of apoptotic cells in these cells. The presence of meroterpenoids may be the cause of this fraction's activity. Studies have shown that extracts from *Sargassum polycystum* can reduce damage caused by cancer cells. [24,25]

ANTI INFLAMMATORY ACTIVITY

Sargassum polycystum has been studied for its anti-inflammatory properties, and research suggests that it may exhibit anti-inflammatory effects due to the presence of bioactive compounds. The seaweed contains various compounds, including polysaccharides, polyphenols, and fucoxanthin, which have been associated with anti-inflammatory activity. Studies have shown that extracts from *Sargassum polycystum* can inhibit inflammatory mediators and pathways, reducing inflammation in experimental models. The anti-inflammatory effects may be attributed to the modulation of pro-inflammatory cytokines, enzymes like cyclooxygenase (COX) and lipoxygenase (LOX), and other inflammatory markers. [26,27].

ANTI DIABETIC ACTIVITY

Sargassum polycystum ethanolic or water extracts dose-dependently decreased dyslipidaemia in rats with type 2 diabetes. Potential insulin sensitizer *S. polycystum* is a supplemental food source. medication in the control of type 2 diabetes, which may lower the risk of atherogenic events. An investigation using the 300 mg/kg water extract and the alcohol extract of *Sargassum polycystum* shown a significant reduction in blood glucose and glycosylated haemoglobin (HbA1C) levels. All seaweed groups showed a significant reduction in serum total cholesterol, triglyceride levels, and plasma atherogenic index following a 22-day treatment period. *Sargassum polycystum*, in contrast to metformin, boosted the rats' responsiveness to insulin but did not significantly alter their plasma insulin levels. Studies proving that *S. polycystum* is a potential insulin sensitiser, for a comestible complementary therapy in the management of type 2 diabetes. [28,29]

OTHER BIOLOGICAL USES

Acne vulgaris: The antioxidant and in vitro antibacterial characteristics of the methanol fractions (F1-F2) acquired during their study project. When looked at column chromatography. The results of the mass spectrometry profile of F1 and F2 indicate that fucoxanthin and chlorophyll are the main anti-acne ingredients; hence, the extract of *Sargassum polycystum* may be a promising material for topical treatment against acne vulgaris. [30]

Cardiac activity: *Sargassum polycystum*, being rich in bioactive compounds like polyphenols, polysaccharides, and omega-3 fatty acids, may have positive impacts on cardiovascular health. Polyphenols, for example, have antioxidant and anti-inflammatory properties that can contribute to overall heart health by reducing oxidative stress and inflammation. One of the key components in the production of blood clots is platelets. Although it is important for maintaining homeostasis, excessive amounts of it can lead to a number of cardiovascular conditions, including coronary artery disease, myocardial infarction, and atherothrombosis. Studies showing that, anti-aggregation activity of crude fucoidan of *Sargassum polycystum* stop blood clot formation and lower the incidence of certain disorders. [31]

Anti stress activity: *Sargassum polycystum* contains various bioactive compounds, including polysaccharides, polyphenols, and fucoxanthin. Some of these compounds have been studied for

their potential effects on the central nervous system and stress-related pathways. The antistress properties of *Sargassum polycystum* polyphenol extracts were assessed. A cold restraint animal stress paradigm was used to compare the anti-stress properties of polyphenol extracts from *Sargassum polycystum* with diazepam. Extracts from *Sargassum polycystum* were given orally at doses of 150 and 450 mg/kg. The typical dosage of the anti-stress medication, diazepam, was 0.18 mg/kg. Good anti-stress effects were seen with both dosages of *S. polycystum* extracts.[32].

II. CONCLUSION

Phytochemical and pharmacological evaluation of *Sargassum polycystum* reveals a fascinating array of potential benefits and applications. phytochemical and pharmacological properties indicate an amazing range of possible advantages and uses. As previously mentioned, *Sargassum polycystum* is a brown seaweed that is highly valued in the field of natural products research due to its abundance of bioactive chemicals. The pharmacological effects of *Sargassum polycystum* are facilitated by the phytochemical ingredients that have been found, such as fucoidans, phlorotannin, and polysaccharides. The wide range of pharmacological activity displayed by *Sargassum polycystum* has been the subject of numerous studies. These include things like antioxidant and anti-inflammatory qualities as well as antidiabetic, anticancer, antimicrobial and antiviral benefits. The bioactive chemicals found in *Sargassum polycystum* present a viable avenue for the creation of innovative medicinal treatments. Apart from its pharmaceutical application, *Sargassum polycystum* exhibits further biological applications. Its uses include agriculture, where it is an effective biofertilizer. In essence, the comprehensive evaluation of *Sargassum polycystum* underscores its multifaceted nature, offering a myriad of possibilities for pharmaceutical, agricultural, and environmental applications. Continued research and exploration of this marine resource may unlock even more potential, paving the way for sustainable and innovative solutions in various fields.

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