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ARTHROSPIRA – NUTRITIONAL VALUE, HEALTH-PROMOTING PROPERTIES AND POSSIBLE USE AS AN ADDITIVE IN DOG NUTRITION. A REVIEW

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Abstract. Arthrospira (*Arthrospira platensis,* trade name spirulina) is commonly called **"**green meat**"** due to its high protein content (up to about 80% of dry matter). It is used in many countries as an additive in human and animal nutrition because of its high nutritional value. Arthrospira protein is of high quality due to the optimal composition of exogenous amino acids. Additionally, Arthrospira is a good source of fatty acids (including GLA, EPA, and DHA). It is used in formulas for complete and complementary pet foods. It can be a valuable source of complete protein for dogs. Its addition can significantly delay the process of lipid oxidation and reduce the number of undesirable microorganisms in the product. The pro-health properties of Arthrospira have been demonstrated in numerous scientific studies, including its effects on hypercholesterolemia, hyperglycemia, cardiovascular diseases, anemia, inflammatory diseases, cancer, and viral infections. The aim of this study was to characterize the nutritional values, health-promoting properties and the possibility of using Arthrospira as an additive in dog nutrition, based on a review of scientific literature.

Key words: spirulina, blue-green alga, feed additives, protein value, fatty acids, dog food, active substances, pro-health effect**.**

INTRODUCTION

Algae are a large group of aquatic organisms, autotrophic and mainly thalloid non-vascular plants, along with prochlorophytes and bacteria. Their classification is complicated due to the vast morphological diversity within algae. This group encompasses over 10,000 species, of which approximately 5% are used as food for humans or as feed for animals. Each species has distinct morphology and properties. The size of these organisms varies depending on the species, ranging from microscopic organisms such as microalgae (arthrospira, chlorella) to macroalgae (seaweeds) that can reach lengths of several meters. Their potential nutritional and therapeutic properties have been well-documented, including antioxidant, anti-inflammatory, anticancer, antimicrobial, anti-

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viral, and anti-obesity effects (Suganya et al. 2015; El-Beltagi et al. 2020; Marková et al. 2020; Alwaleed et al. 2021; Mahmoud et al. 2021; Tajvidi et al. 2021). These properties of algae have the potential to be developed into new therapies in both human and veterinary medicine.

Algae and products derived from them are also used as potential resources for livestock and companion animal feed and nutrition (Raja et al. 2018; Cabrita et al. 2022). Feed materials include live or processed algae-fresh, chilled, or frozen algae, dried algae, algae meal, algae oil, as well as water or alcohol extracts and meal from seaweeds (Reg. 1017/2017).

The best-studied cyanobacteria species belonging to the family Microcoleaceae with pharmacological and food industry applications are *Arthrospira platensis* and *Arthrospira maxima* (known as spirulina due to their spiral or helical shape). In most industrial applications, the name “spirulina” (although incorrect) is easier to pronounce and remember, thus more suitable from a marketing perspective. Currently, a wide range of studies have confirmed that *Arthrospira* and *Spirulina* represent two independent genera, each classified in different orders, and besides having spiral filaments, they have minimal morphological similarity (Nowicka-Krawczyk et al. 2019). *A. platensis* and *A. maxima* belong to bacteria of the genus *Arthrospira* Stizenberger ex Gomont, 1892, of the order Oscillatoriales, free-floating cyanobacteria in the form of cylindrical, multicellular, filamentous colonies (Madkour et al. 2012; Junior et al. 2020). They are the most cultivated microalgae worldwide, accounting for over 30% of global microalgal biomass production.

Microalgae are not only a rich source of diverse valuable substances but also a vital component of ecosystems. They serve as food for organisms living in water (at the beginning of most food chains in aquatic ecosystems), enrich water bodies with oxygen, and regulate access to sunlight. Microalgae require a small cultivation area, their growth is not season-dependent, they synthesize protein from inorganic nitrogen, exhibit rapid growth, and double their biomass in a short time (Rehman et al. 2022; Udayan et al. 2022). Arthrospira can be cultured and grown in extreme conditions (saline environments and high pH substrates), which makes it considered a highly hygienic food source, as most pathogenic microorganisms cannot survive in such harsh conditions (Nosratimovafagh et al. 2022).

Arthrospira has a wide range of applications in the food industry, cosmetology, and medicine for a long time (da Silva et al. 2016; Nowruzi et al. 2020; Torres-Tiji et al. 2020; Favas et al. 2022). The US Food and Drug Administration (FDA) has granted it the status of “generally recognized as safe” (GRAS) (Marles et al. 2011). It has also been classified as a novel food (European Commission Official Website, https://webgate.ec.europa.eu/fip/novel_food_catalogue/). Although products derived from Arthrospira are considered safe, it is important to be aware that since Arthrospira can coexist in the same environment with other potentially toxic cyanobacteria, the products obtained from them may be contaminated with toxins produced by other undesirable organisms. However, it has been demonstrated that cyanotoxin contamination is a problem in strains of Arthrospira cultivated in unmonitored environments such as ponds or lakes (Manali et al. 2016; Roy-Lachapelle et al. 2017). Low concentrations of toxins produced by cyanobacteria present in products containing Arthrospira do not pose a significant health risk (Papadimitriou et al. 2021). Products containing Arthrospira appear to have no side effects with regular consumption. However, it is advisable to thoroughly check the supplemented product. Studies examining 46 powdered and/or tablet supplements containing Arthrospira for amino acid content, fatty acids, mineral components, as well as toxic elements and their compliance with product declarations and possible adulteration, revealed that trace toxic elements do not pose a serious health risk, but attention should be paid to the high percentage (87%) of incorrect declarations regarding the content of certain macro- and microelements among the analyzed supplements.

The emphasis is primarily on the potential benefits of using Arthrospira to improve healthcare both in space and on Earth (Fais et al. 2022; Mapstone et al. 2022). Numerous research results focusing on humans and laboratory animals have already been published (García et al. 2017; Amadeu et al. 2023). However, there are still few scientific publications regarding the use of Arthrospira in the nutrition and disease prevention of domestic animals. Therefore, it is worthwhile to gather information about these organisms, especially in terms of their application in the daily life of dogs, considering the growing population, which necessitates the search for alternative sources of nutrition for animals, particularly those rich in protein (Pestana et al. 2020; Altmann and Rosenau 2022; Spínola et al. 2022). There is also an increasing number of pet products containing algae from the genus Arthrospira. These products are either 100% based on Arthrospira or blends containing other sources of nutrients (Masten Rutar et al. 2022).

The aim of this study was to characterize the nutritional value, health properties, and possibilities of using Arthrospira as a supplement in dog nutrition based on a review of scientific literature.

NUTRITIONAL VALUE

Fresh microalgae are characterized by high moisture content (over 80%). Therefore, dried products are used to reduce the water content to a level where the growth of microorganisms responsible for product spoilage is minimized, thereby extending its shelf life. The two most common drying methods used are spray drying and freeze-drying (Abbaspour-Gilandeh et al. 2019; Seghiri et al. 2019).

PROTEIN

With the increasing population of dogs (FEDIAF 2022), there is a growing demand for nutrients, particularly high-quality protein. From a nutritional perspective, microorganisms can serve as valuable sources of high-quality protein. Arthrospira, also known as "green meat", can contain approximately 80% protein in dry matter (DM, Table 1).

Table 1. Content of protein (% dry matter, DM), essential amino acids (g/16 g N) and *Arthrospira platensis* protein nutritional index (Niccolai et al. 2019; Molfetta et al. 2022)

Item	Content
Moisture (% dry biomass)	9
Protein	75
Arginine, Arg	7.3
Histidine, His	2.2
Isoleucine, Ile	6.7
Leucine, Leu	9.8
Lysine, Lys	4.8
Methionine, Met	2.5
Methionine+Cysteine, Met+Cys	3.4
Phenylalanine, Phe	5.3
Phenylalanine+Tyrosine, Phe+Tyr	10.6
Treonina, Thr	6.2
Tryptophan, Trp	0.3
Valine, Val	7.1
Σ EAA	58.4
$AAS_{Met+Cys}$	60

EAA – essential amino acids; AAS – limiting amino acid index.

This protein is of high quality, well-digested by animals, and can be an excellent source of this macronutrient in formulations. The in vitro protein digestibility of *Arthrospira platensis* is over 81% (Niccolai et al. 2019). Its high quality is attributed to the presence of essential amino acids, including leucine, isoleucine, valine, lysine, threonine, tryptophan, and phenylalanine. The nutritional value, as determined by the limiting amino acid score (CS, chemical score), is higher compared to plant-based proteins and, when supplemented with methionine, comparable to animal-based proteins. Arthrospira is a rich source of lysine, but attention should also be given to the high level of phenylalanine. This essential amino acid is helpful in behavioral disorders and supports weight reduction. Of course, it should be treated as a dietary supplement, and the foundation should always be the implementation of an appropriate weight-loss program. The protein in Arthrospira has a digestibility of 85–90% due to the absence of cellulose in the cell wall (Souza et al. 2019).

CARBOHYDRATES

Arthrospira contains carbohydrates in the range of 10–25% of dry matter. Dietary fiber constitutes 8–15% of dry matter. The cell walls of Arthrospira contain compounds such as alginic acid and fucans (laminarin and fucoidan). Alginic acid has immunostimulating, moisturizing, and regenerating effects on the skin, as well as the ability to bind toxins. Studies have shown that alginic acid increases the concentration of hormone-sensitive lipase, leading to enhanced lipolysis and consequent reduction in fat accumulation in the body (Park et al. 2011). In experiments on laboratory animals, alginic acid has been found to increase work capacity, prevent fatigue, and activate recovery processes following muscle activity (Khasina et al. 2001), making Arthrospira an excellent supplement for active dogs. A diet containing alginates increases the population of *Bifidobacterium bifidum* and *Bifidobacterium longum* while reducing the abundance of bacteria from the *Enterobacteriaceae* family and enterococci (Wang et al. 2006; Pinna et al. 2021). Similarly, fucans have demonstrated prebiotic properties in studies involving domestic animals (O'Sullivan et al. 2010). Laminarin and fucoidan are sulfated polysaccharides. Fucoidan exhibits antioxidant, immunostimulating, anticancer, anti-inflammatory, antibacterial, antiviral, and antithrombotic activities. In in vitro and in vivo studies, fucoidan has been shown to impact cancer cells, including those of lung and colon cancer, by inducing apoptosis and inhibiting their growth (Jękot et al. 2015). Fucoidan also inhibits the development of inflammation by reducing the migration of white blood cells and the expression of certain inflammatory mediators, which is closely related to its analgesic effects (Albuquerque et al. 2013). Additionally, it exhibits hepatoprotective properties (Mohamed et al. 2021).

FATTY ACIDS

Arthrospira is an excellent source of fatty acids (Table 2). Among the monounsaturated fatty acids (MUFA), oleic acid (C18:1, n-9) predominates. Oleic acid is involved in hormonal regulation and immune system function (Meng et al. 2019). It contributes to the oxidative stability of the fat and, therefore, Arthrospira exhibits high resistance to fatty acid oxidation (Frega et al. 1999). The fat present in Arthrospira contains approximately 28% polyunsaturated fatty acids (PUFA) (Diraman et al. 2009), including mainly γ-linolenic acid (GLA, C18:3) and linoleic acid (LA, C18:2) from the n-6 family, and α-linolenic acid (ALA, C18:3), eicosapentaenoic acid (EPA, C20:5), and docosahexaenoic acid (DHA, C22:6) from the n-3 family. The content of long-chain polyunsaturated fatty acids (LC-PUFA) DHA and EPA in Arthrospira is almost 100 times higher than in mother's milk (Raji et al. 2020; Zhang et al. 2022). It has been shown that adding 0.4% Arthrospira (providing 814 mg DHA/

kg) to commercial dry dog food resulted in better oxidative stability compared to the control with sardine oil (Souza et al. 2019). The high concentrations of β-carotene, vitamin E, sterols, phenols, and flavonoids, which are abundant in this microalgae, may also influence oxidative stability (Junwei et al. 2015). The addition of 0.4% Arthrospira also increased palatability, nutrient digestibility, and energy, while reducing blood cholesterol levels in the tested dogs.

Table 2. Content of crude fat (% DM) and selected fatty acids (% fat) in *Arthrospira platensis* (Diraman et al. 2009)

Item	Content
Crude fat	6
Saturated fatty acids, SFA	
butyric acid C4:0	1.81
caproic acid C6:0	1.62
caprylic acid C8:0	1.01
lauric acid C12:0	0.37
Unsaturated fatty acids, UFA	
oleic acid C18:1, n-9	20.35
linoleic acid C18:2, n-6	13.21
γ-linolenic acid C18:3, n-6	7.12
α-linolenic acid C18:3, n-3	0.93
eicosapentaenoic acid C20:5, n-3	1.79
docosahexaenoic acid C22:6, n-3	2.28
Σ SFA	38.19
Σ MUFA	29.71
Σ PUFA	28.20
PUFA/MUFA	0.95

MINERAL COMPONENTS

Arthrospira is an excellent source of various macro- and microelements (Table 3). These elements are present in highly bioavailable forms, either as complex compounds or metalloorganic compounds. Particularly noteworthy is the iron derived from Arthrospira, which is absorbed twice as efficiently as iron from animal products or commonly used preparations such as iron sulfates. This is due to the porphyrin structure of phycocyanin found in the algal cells, which is capable of forming complexes with iron.

VITAMINS

Arthrospira is considered a very good source of many vitamins, both water-soluble and fat-soluble (Table 4). It is rich in cobalamin (vitamin B12) and its analogues (Kumudha et al. 2010; Ragaza et al. 2020). Arthrospira contains over three times more vitamin B12 than beef liver, which is considered a very good source of this vitamin (Bito et al. 2018). Preparations containing Arthrospira can effectively supplement vitamin A deficiencies. The β-carotene content in Arthrospira is extremely high and is approximately 30 times higher than in carrots (Ragaza et al. 2020).

PIGMENTS

Arthrospira also contains phycobiliproteins, including phycoerythrin (PE) and phycocyanin (PC) (Table 5). Phycoerythrin is a red pigment, while phycocyanin is a blue pigment that imparts the characteristic dark turquoise color to *A. platensis*. These pigments belong to a large group of phycobiliproteins and have the ability to neutralize free radicals. They have been shown to have anti-inflammatory, neuroprotective, hepatoprotective, immunomodulatory, antiviral, antibacterial, antifungal, and anticancer properties (Afreen and Fatma 2018). Due to the presence of phycocyanin (C-PC, C-phycocyanin), Arthrospira reduces the release of immune system proteins by 70%, which can trigger a cytokine storm in the lungs leading to acute respiratory failure and organ damage (Tzachor et al. 2021). Cytokine storm is highly dangerous for the body and is characteristic of severe COVID-19 cases (Pedersen and Ho 2020).

Table 3. Comparison of the level of essential minerals in *Arthrospira platensis* to the nutritional guidelines (Seghiri et al. 2019; da Silva et al. 2021; Ramírez-Rodrigues et al. 2021; Masten Rutar et al. 2022)

Item	*Arthrospira platensis*	MRL
Crude ash (g in 100 g DM)	7	–
Macroelements (in 100 g DM)		
Calcium, g	0.7	0.5
Phosphorus, g	0.8	0.4
Potassium, g	1.6	0.5
Sodium, g	0.9	0.1
Magnesium, g	0.4	0.07
Microelements (in 100 g DM)		
Copper, mg	1.20	0.72
Iron, mg	49.80	3.60
Manganese, mg	1.30	0.58
Selenium, μg	16	23[a]/18[b]
Zinc, mg	5.00	7.20
Iodine, μg	30	–

MRL – minimum recommended level (FEDIAF 2021) for an adult dog at maintenance energy requirement (MER) = 110 kcal/kg$^{0.75}$; [a] for wet complete food; [b] for dry complete food.

Table 4. Content of selected vitamins (mg/100 g DM) in *Arthrospira platensis* (Ali and Saleh 2012)

Item	Content
β-carotene (provitamin of vitamin A)	140
Tocopherol (vitamin E)	100
Thiamin (vitamin B1)	3.50
Riboflavin (vitamin B2)	4.00
Niacin (vitamin B3)	14.00
Pyridoxine (Vitamin B6)	0.80
Biotin (vitamin B7)	0.01
Folic acid (vitamin B9)	0.01
Cobalamin (vitamin B12)	0.32
Phylloquinone (vitamin K)	2.20

Table 5. Content of selected pigments (µg/g of algae) in *Arthrospira platensis* (Osório et al. 2020)

Item	Content
Total chlorophyll	10253
Carotenoids	1264
Phycoerythrin	8180
Phycocyanin	20732

PRO-HEALTH EFFECTS AND USE OF ARTHROSPIRA IN THE DIET

In recent years, numerous positive benefits of the components found in Arthrospira have been demonstrated, including antioxidant, immunomodulatory, anti-inflammatory, and antibacterial properties (Manzo et al. 2017; Guzmán-Gómez et al. 2018; Rodríguez-Luna et al. 2018; Satyaraj et al. 2021). Arthrospira also exhibits prebiotic properties and modulates the microflora of the gastrointestinal tract (Patel et al. 2021).

Administration of Arthrospira to animals with rheumatoid arthritis for a period of 8 days at a dose of 800 mg/kg body weight resulted in increased body weight compared to the control group. In rheumatoid joint disease, weight loss can be associated with reduced absorption of glucose and lecithin from the intestine, while the use of Arthrospira restores the absorptive capacity of the small intestine. The addition of Arthrospira also inhibited limb edema, which was attributed to a decrease in lysosomal hydrolase levels. The reduction of edema by Arthrospira is associated with its interference in cyclooxygenase metabolism. Arthrospira supplementation reduces the levels of aminotransferase and alkaline phosphatase in the blood, which is also linked to its anti-inflammatory properties (Rasool et al. 2006).

As is commonly known, paracetamol is toxic to both dogs and cats (Dziekan et al. 2012). In dogs, a dose exceeding 500 mg/kg body weight can lead to severe, irreversible, and toxic liver damage (Richardson 2000). Acetaminophen-induced liver damage is characterized by increased lipid peroxidation and decreased glutathione levels, an antioxidant present in the liver. Animals receiving Arthrospira (800 mg/kg body weight) showed increased glutathione levels compared to animals with damaged liver that did not receive Arthrospira supplementation (Sabina et al. 2009). Additionally, the Arthrospira supplementation group showed increased levels of enzymes such as superoxide dismutase, glutathione peroxidase, glutathione reductase, and glutathione S-transferase, resulting in reduced lipid peroxidation in the liver. These enzymes have antioxidant properties and play an important role in eliminating reactive oxygen species. It is believed that vitamin E and β-carotene, which act as antioxidants, are responsible for this effect, and Arthrospira is a rich source of these compounds.

The antioxidant activity of Arthrospira can also be utilized in the prevention of behavioral changes associated with the aging process in dogs. Similar changes to Alzheimer's disease in humans, including the deposition of β-amyloid plaques in the cortical region of the brain, are present in the brains of mature dogs diagnosed with cognitive dysfunction syndrome (CDS) (Kudla et al. 2014). An experiment on mice demonstrated that supplementation with Arthrospira at a dose of 200 mg/kg body weight significantly reduced the amount of β-amyloid plaques in the hippocampus. Supplementation also contributed to increased activity of antioxidant enzymes such as catalase (Hwang et al. 2011).

When it comes to dogs, including mature ones, it is important to consider the presence of an appropriate level of LC-PUFAs in their diet. Administering an oil supplement extracted from Arthrospira containing 0.1% DHA to dogs aged 8 to 11 years has been shown to enhance cognitive abilities in older dogs (Hadley et al. 2017).

Arthrospira possesses antibacterial properties, including activity *against Staphylococcus aureus* MTCC 96, *Salmonella typhimurium* MTCC 98, *Escherichia coli* MTCC 443, *Pseudomo-*

nas aeruginosa MTCC 424, and *Proteus vulgaris* MTCC 426 (Bhowmik et al. 2009; Kumar et al. 2011). It has been demonstrated that Arthrospira promotes the growth of lactic acid bacteria, which are classified as probiotic organisms and help maintain a balance between harmful and beneficial microorganisms in the gastrointestinal tract, thereby improving intestinal absorption (Bhowmik et al. 2009).

The positive impact of Arthrospira supplementation in the diet of dogs on gut microbiota can be observed after just one month of use (Delsante et al. 2022). Supplementing dogs' diets with Arthrospira at a concentration of 0.2% has a prebiotic effect on the stability of gut flora in dogs, resulting in an improved immune response (Satyaraj et al. 2021). It has also been demonstrated in laboratory animals that Arthrospira supplementation at a concentration of 3% in a high-fat diet for three months inhibits chronic inflammation, gut dysbiosis, and modulates intestinal permeability (Yu et al. 2020).

Arthrospira may also reduce the risk of cardiovascular diseases (CVD). It is believed that Arthrospira inhibits cholesterol absorption in the small and large intestine, as well as the resorption of bile acids, suggesting that C-phycocyanin is responsible for this effect. Additionally, it exhibits inhibitory effects on pancreatic lipases. The hypotensive effect of Arthrospira extract is attributed to C-phycocyanin, which inhibits platelet aggregation by blocking calcium mobilization and the release of free radicals by platelets. The low sodium and high potassium content (Table 3) in Arthrospira may play a positive role in lowering blood pressure (Torres-Duran et al. 2007). Arthrospira has been shown to have anti-atherosclerotic effects in white New Zealand rabbits with hypercholesterolemia induced by a high-cholesterol diet (HCD) containing 0.5% cholesterol for four weeks, followed by supplementation with HCD supplemented with 1% or 5% Arthrospira (SP1 or SP5) for an additional eight weeks. Two months of Arthrospira supplementation contributed to a reduction in serum triglyceride and total cholesterol levels, as well as low-density lipoprotein (LDL) cholesterol levels (Cheong et al. 2010). In cats fed a high-cholesterol diet, supplementation with concentrated *A. platensis* lowered serum cholesterol levels (Shamsudin et al. 2018). The doses of Arthrospira used were 0.5 and 1.0 g/kg body weight per day. Therefore, Arthrospira may be an effective supplement in reducing risk factors for cardiovascular diseases. Future studies should investigate whether similar effects can be obtained in experiments involving dogs.

Products containing Arthrospira are also used as supportive treatment for skin problems. GLA contributes to the reconstruction and protection of the skin's barrier layer, protects the skin from infections, and alleviates inflammation. Additionally, it soothes irritations, redness, and counteracts dryness and scaling of the skin. Clinical studies in atopic dogs have shown positive effects of diet enrichment with a combination of EPA, DHA, and GLA (Abba et al. 2005). Significant improvement was observed in animals with early signs of atopy compared to those with chronic atopy. In dogs with atopic dermatitis, disturbances in the structure of extracellular lipid lamellae have been found, as they are thinner and not continuously arranged (Piekutowska et al. 2008). As a result, wounds and injuries heal more slowly in these animals, and penetration of allergens and other irritating substances is facilitated. Topical application of Arthrospira has been found to accelerate wound healing and may be used for the treatment of various skin wounds, potentially providing a molecular basis for future promising scar-reducing agents (Elbialy et al. 2021).

Arthrospira is also recommended as a supplement for mature animals due to the presence of the aforementioned PUFAs. With age, senior animals experience gradual loss of skin elasticity. PUFA, especially from the n-6 family, supports ceramide synthesis in the skin, protecting it from excessive water loss and improving its elasticity. Gel products containing Arthrospira are available on the market, providing constant moisture, absorbing exudates and dead cells, and ensuring airflow to the wound.

CONCLUSIONS

Arthrospira has a wide range of applications in the food industry, cosmetology, medicine, and can also be used in pet nutrition. It is not only a high-quality source of protein, but it also contains a wealth of metabolites that are beneficial for health and therapeutic purposes. In terms of its content of gamma-linolenic acid, phycobilins, vitamins (especially B-group vitamins), vitamin E, beta-carotene, and essential minerals (Fe, Se, Zn, Cu), Arthrospira surpasses many other known food sources used in dog diets. It can be successfully used as a dietary supplement to support the proper functioning of a dog's body, particularly in cases of dogs with intestinal dysbiosis or mature dogs to support their cognitive functions. Due to its proven beneficial effects in treating periodontal diseases and reducing the accumulation of dental plaque, it can also be used preventively. Arthrospira has the potential to become an important food source in the future and can be used as an ingredient in the development of functional food. However, further research is necessary to better understand its impact on animal health.

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ARTROSPIRA – WARTOŚĆ ODŻYWCZA, WŁAŚCIWOŚCI PROZDROWOTNE I MOŻLIWOŚCI WYKORZYSTANIA JAKO DODATEK W ŻYWIENIU PSÓW. PRZEGLĄD LITERATURY

Streszczenie. Artrospira (*Arthrospira platensis,* nazwa handlowa: spirulina) ze względu na wysoką zawartość białka (do ok. 80% suchej masy) nazywana jest powszechnie „zielonym mięsem". Wykorzystywana jest w wielu krajach jako dodatek w żywieniu ludzi i zwierząt ze względu na dużą wartość odżywczą. Wysoka jakość białka artrospiry wynika z optymalnego składu aminokwasów egzogennych. Oprócz tego artrospira jest również dobrym źródłem kwasów tłuszczowych (w tym GLA, EPA i DHA). Stosowana jest w recepturach karm pełnoporcjowych i uzupełniających. Może być cennym źródłem pełnowartościowego białka dla psów. Jej dodatek może znacznie opóźnić proces utleniania lipidów i zmniejszyć liczbę niepożądanych drobnoustrojów w produkcie. Wykazano w licznych badaniach naukowych jej prozdrowotne właściwości m.in. w hipercholesterolemii, hiperglikemii, chorobach układu krążenia, anemii, chorobach zapalnych, nowotworowych i infekcjach wirusowych. Celem ni-

niejszej pracy była charakterystyka wartości odżywczych, właściwości prozdrowotnych i możliwości wykorzystania artrospiry jako dodatku w żywieniu psów na podstawie przeglądu literatury naukowej.

Słowa kluczowe: spirulina, niebieskozielone algi, dodatki paszowe, wartość białka, kwasy tłuszczowe, karma dla psów, substancje aktywne, działanie prozdrowotne.