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Review Article

Examination of Studies on Ultrasound Applications on Fish Species and Connection with Aquatic Mammals

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Abstract

Today, ultrasonographic examination is used in the sex discrimination of fish and in the control of the development of the gonads, eggs and sperm of the fish before fertilization. Tissue elasticity and density, which also helps the eating quality of fish, can also be determined by ultrasound. In addition, the most important is the use of ultrasound in the diagnosis of diseases. Especially in the spleen, liver and kidneys; It helps in the examination of swelling caused by granulomatous, fungal, bacterial and parasitic diseases, in the detection of anatomical disorders and in the general control of internal organs, by applying ultrasound quickly and reliably without any stress and harm to the fish.

In addition, the fact that ultrasound is a natural feature of dolphins, which is a marine mammal, can be said to be a kind of imitation of nature. The usage area of ultrasound is increasing day by day.

In this article, studies on the use of ultrasound in fish are reviewed

Keywords: Aquatic Mammals; Fish Species

Introduction

There are more than one reason why humanity is interested in fish, the most important of which is that it is a very important food source. Moreover, the belief in the limitlessness of this resource was based on until recently [1].

We know that Aristotle had considerable knowledge of fish species. This shows that fish entered philosophy in ancient times. But the most important turning point in the world of fish science was the middle of the 20th century, when scuba technology developed. Being under water for a longer period of time and in comfortable conditions created the opportunity to study fish not only in terms of species, but also in behavior and ecology [1].

Taxonomic sorting studies, primarily examining the anatomical and physiological structures of fish, continue. In addition, deeper knowledge is needed for fish breeding, fish diseases and their treatment. With the development of science and, accordingly, technology, we can reveal their histological structures. We can reveal many more data with microbiological and virological examinations [17].

With the development of ultrasonography in the 20th century, new methods have been used in both imaging and treatment. Ultrasonography is a radiological method used in the examination of soft tissues. It is an imaging method based on sending high-frequency sound waves to the area to be examined and their reflection from different tissue surfaces [2].

Ultrasound is a non-ionizing, non-invasive and non-polluting form of mechanical energy as an acoustic energy (Chemat, Huma, and Khan, 2011). Ultrasound is a mechanical vibration energy in

solid or fluid at a frequency higher than the maximum frequency audible to the human ear (16-18 kHz). The lowest ultrasonic frequency is 20 kHz and the upper limit is accepted as 5MHz for gases and 500MHz for liquids and solids (Mason and Lorimer, 2002) [2].

Ultrasound uses are generally divided into two groups. Low power ultrasound applications often involve the use of low power (up to 10 W) high frequencies (2-10MHz). Low-power ultrasound is non-destructive and is widely used as a diagnostic tool in medicine and chemical analysis (Florosand and Liang, 1994). The application of low ultrasound (density less than 1 W/m2, frequency higher than 100 kHz) has been successfully used in applications such as diagnosing the physicochemical properties of food, surface cleaning, enzyme inactivation, crystallization, emulsification, filtration, freezing and ripening of meats (Thakurand and Nelson, 1997). The other group is power ultrasonics using high power levels (10 kW-100 W) and low frequencies (20 kHz and 100 kHz). The physical, mechanical or chemical effects of ultrasonic waves in this range can change the material properties by creating and spreading the enormous pressure, shear and temperature gradient in the environment (for example, disrupting the physical integrity, accelerating some chemical reactions) (Mason and Lorimer, 2002). In recent years, studies on the use of this type of ultrasound applications as a food preservation method have increased (McClements, 1995) [2].

Uses of ultrasound on fish

Today, ultrasonographic examination is used in the sex discrimination of fish and in the control of the development of the gonads, eggs and sperm of the fish before fertilization. Tissue elasticity and density, which also helps the eating quality of fish, can also be determined by ultrasound. In addition, the most important is the use of ultrasound in the diagnosis of diseases. Especially in the spleen, liver and kidneys; It helps in the examination of swelling caused by granulomatous, fungal, bacterial and parasitic diseases, in the detection of anatomical disorders and in the general control of internal organs, by applying ultrasound quickly and reliably without any stress and harm to the fish [8-11].

Examinations of Rainbow Trout (*Oncorhynchus mykiss* Walbaum, 1792) with using ultrasonography.

In this study, we see the examination of rainbow trout sampled between the ages of 2-5, both live and under anesthesia. This study serves as a guide for each study or treatment that will be studied with this species in the future. It is functional in distinguishing the pathological conditions of the species from the normal ones.

In the ultrasonographic examination, eye, spine, liver, air sac, ovary, testis, pyloric seca, and stomach displayed. Also found interesting by researchers; Ultrasound detection of a mature egg occurred during the breeding period of a 4-year-old female trout. The gonads are light and granular in female fish, and dark in color in males [8].

Although the location, shape and functions of the internal organs are normally present in most classical information anatomically, the fact that these organs were visualized for the first time in trout (*Oncorhynchus mykiss*) ultrasonographically and this subject constitutes a beginning in aquaculture with basic information has increased the importance of such a study [8].

Ultrasound study on a species

In this study, the effects of the cleaning feature of ultrasound; It was determined by microscopic methods on the green algae *Chlorella variabilis* and then on various tissues (gill, liver, heart and brain tissues) of *Carassius auratus* species with different parameters (biochemical, histological, behavioral).

Depending on their specific energies, CAT enzyme activity, GSH amount and AChE enzyme activity increased while total protein amount decreased in bath type sonicator application; In horn type sonicator application, CAT enzyme activity, GSH amount, MDA amount and AChE enzyme activity decreased while total protein amount increased. Histological damages in gill tissues in bath type sonicator application depending on their specific energies; edema, hypertrophy, hyperplasia, and central vein dysfunction; In horn type sonicator application, hyperplasia, edema, aneurysm and central vena stenosis were determined. When approached from a behavioral point of view, inverted abdomen, slowed swimming, and unresponsiveness are observed in bath type sonicator application depending on their specific energies; In the horn type sonicator application, swimming slowing and unresponsiveness were observed, but inverted abdomen was not observed [12].

In conclusion; this thesis will provide a guide for the effects of future ultrasound studies on this species.

Determine sex and gonad size in fishes

This has been the most used area among the usage areas of ultrasonography in fish. Sex determination and determination of the size of the gonads are important parameters in terms of productivity. Many studies and articles have been written on this subject.

In a study by Martin and Rommens, juvenile and mature flounder *Hippoglossus hippoglossus* (Linnaeus), mature winter *Pleuronectes americanus* (Walbaum) and yellowtail ¯ounder *Pleuronectes ferruginea* (Storer), and mature haddock Melanogrammus aegle®-nus (Linnaeus ultrasound images for sexing) usage has been studied.

In another study, sex determination was studied in sturgeon fish. The ultrasonographer interpreted the appearance of the gonads, and gender was identified according to the brightness relative to the adjacent tissues (echogenicity), fine or course graininess (echotexture), and uniformity (homogeneity versus heterogeneity) of the gonadal tissue. Hyperechoic gonads with fine echotexture and an overall homogeneous composition were identified as male. Female fish were identified by having gonads that were more coarse in overall echotexture and heterogeneous, with a tortuous (S-shaped) centrally located hyperechoic band [14].

Sturgeon in right lateral recumbency examined by ultrasonographic transducer positioned ventral to the lateral scutes and dorsal to the abdominal scutes [14].

In the endoscopic view of the testis of a 4-year-old male Siberian sturgeon in this study, the surface appeared smooth with a sinusoidal pattern. In the endoscopic view of the ovary of a 3-year-old female Siberian Sturgeon examined next, tiny oocytes invisible to the naked eye could be clearly identified and observed interspersed in the gonadal fat [14].

Another Use: Monitoring the Healing Process with Ultrasound

This work aimed to carry out an in vivo study of the skin healing process in gilthead seabream (*Sparus aurata*) after being experimentally wounded. Through the ultrasonography images, both the skin structure and the evolution of the changes that wounds originated in the surrounding tissues were studied in vivo over time [15].

A Different Perspective on the Subject 'Natural Ultrasound Feature of Aquatic Mammals'

The therapeutic use of dolphins officially started in the 1970s and has become a profitable business in many countries such as the USA, Mexico, Israel, Russia, Japan, China and the Bahama. However, many positive and negative things are said about these therapy centers. When the positive effects of physical contact between dolphins and humans are investigated in terms of physiological and psychological aspects, it is known that successful results are obtained in various fields related to disabled children who need different education from normal children.

In the dolphin play therapy method, it has been observed that children who cannot communicate with the world around them easily communicate with dolphins. This feature is used in their education [16]. Nathanson, professor of educational psychology working on this subject in the USA, states that swimming with dolphins affects the secretion of endorphins in children with autism, stimulating the immune system and accelerating the production of T cells (defense cells of our body). Nathanson states that physical limitations and obstacles in humans are perceived by the natural sonar system of dolphins, and positive results are obtained, especially when bottlenose dolphins are used in therapy with children with autism [16].

Under the control of physicians and a dolphin trainer, these animals instinctively know how to contact and communicate with patients. During this contact, powerful and potent possibilities emerge that no medicine or physician can mobilize. These cetaceans probably feel the characteristic vibration of the sick organs when probing the patient by ultrasound [16]. As a result of the researches, it has been understood that the spine and brain enter into resonance vibration during ultrasound irradiation and this stimulates the production of various biochemical substances that enable the nervous system to work better. During the direct contact with the dolphin, therefore, the feelings of fear, stress and tension decrease, the person feels that positive energies are flowing and is purified from negative emotions [16].

This information, obtained as a result of the evaluations, reveals the reality of the use of ultrasound technology for treatment and therapy purposes. With some improvements in the devices, perhaps this type of use of marine mammals will be replaced by mechanical devices. Thus, practices that are inconvenient in terms of animal welfare will be limited.

Conclusion

The fact that ultrasound studies have been done less in aquatic creatures than in other living things reveals the data gap. In addition, we see that when examined in terms of sex determination, gonad quality and gonad development, it will be possible to engage in activities that will greatly affect productivity.

The study, in which the common aspect of ultrasound with the feature of marine mammals is mentioned, offers the opportunity to take an important step in animal welfare.

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