

# II.INTERNATIONAL HYGIENE CONFERENCE

24 AUGUST, 2022 ANKARA, TURKEY

## PROCEEDINGS BOOK

EDITORS  
AGİT FERHAT ÖZEL  
GAMZE TURUN

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# II.INTERNATIONAL HYGIENE CONFERENCE

24 August,2022 ANKARA

# II.ULUSLARARASI HİJYEN KONGRESİ

24 Ağustos,2022 ANKARA

## Proceedings Book

Editors

Agit Ferhat ÖZEL

Gamze TURUN

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**II.INTERNATIONAL HYGIENE CONFERENCE**

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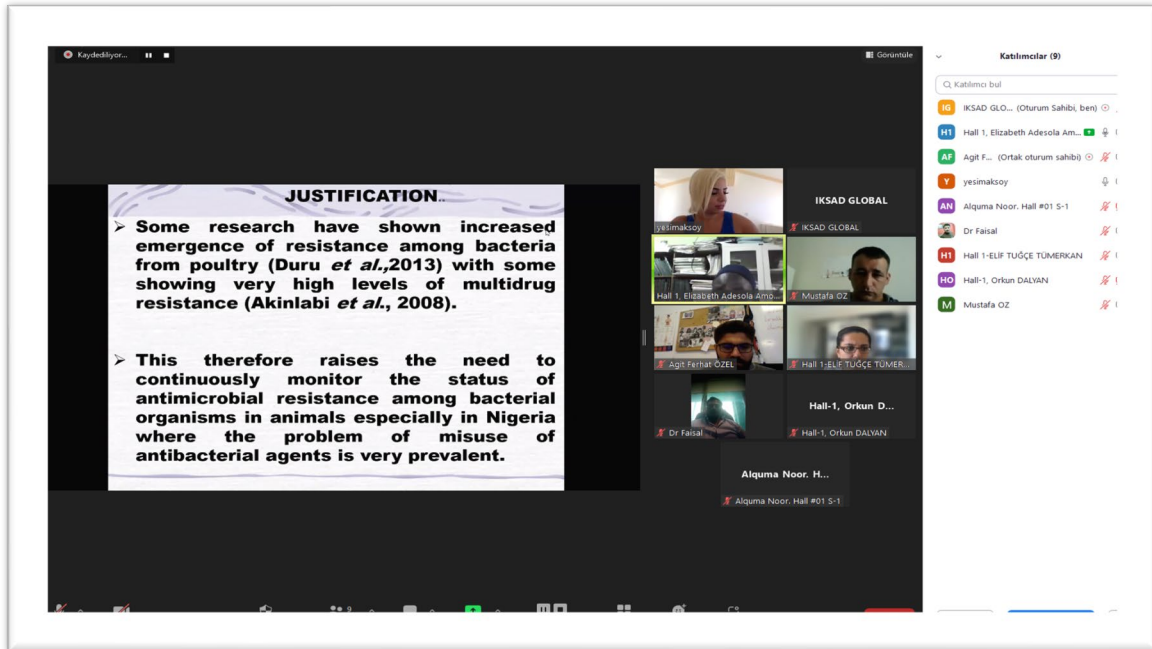
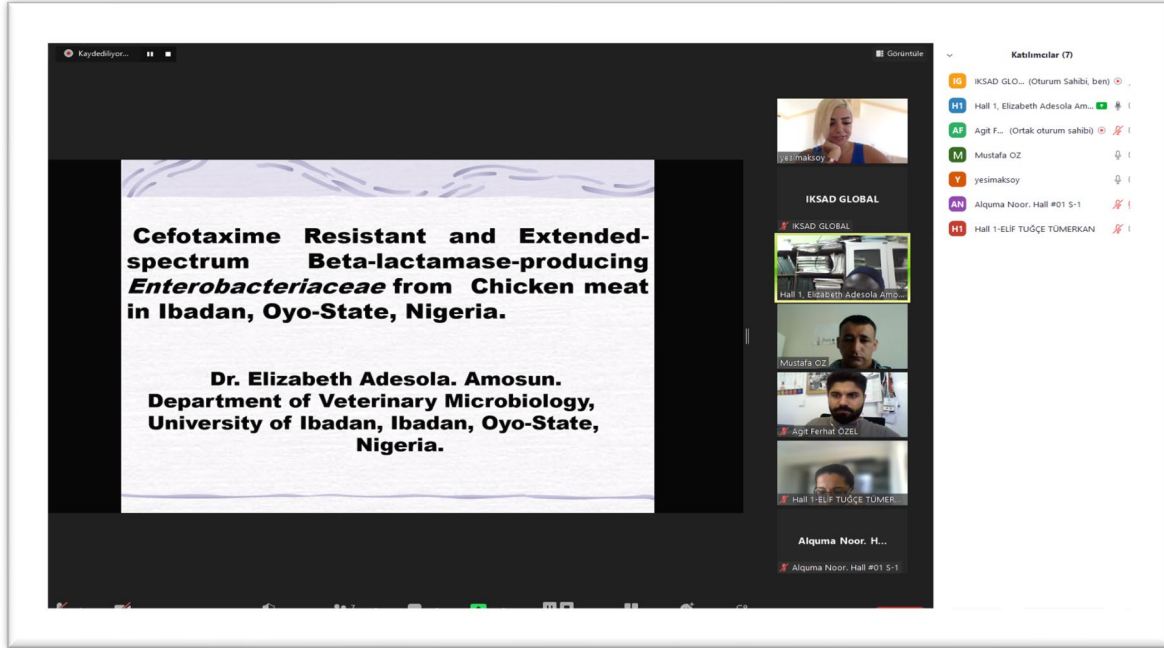


**DATE: 24.08.2022**  
**ANKARA LOCAL TIME: 10<sup>00</sup>-12<sup>30</sup>**  
**SESSION -1, HALL - 1**

**Head of the Session: Assoc.Prof.Dr. Yeşim Üstün Aksoy**

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Fakhar ud Din Sidra Bashir Muhammad Moneeb Kainat Niusheen Sara Imtiaz	<i>Quaid-i-Azam University Quaid-i-Azam University Quaid-i-Azam University Quaid-i-Azam University Quaid-i-Azam University</i>	SMART ANTIFUNGAL DRUG DELIVERY SYSTEM: IN VITRO RELEASE, PHARMACOKINETICS AND SAFETY STUDY

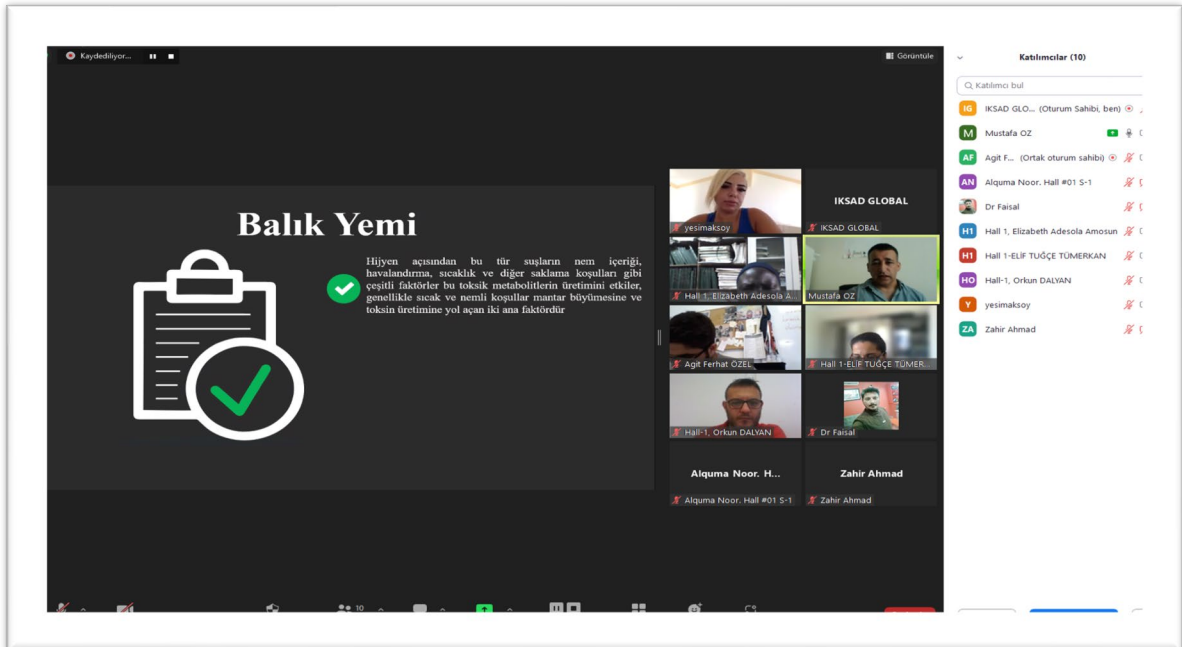
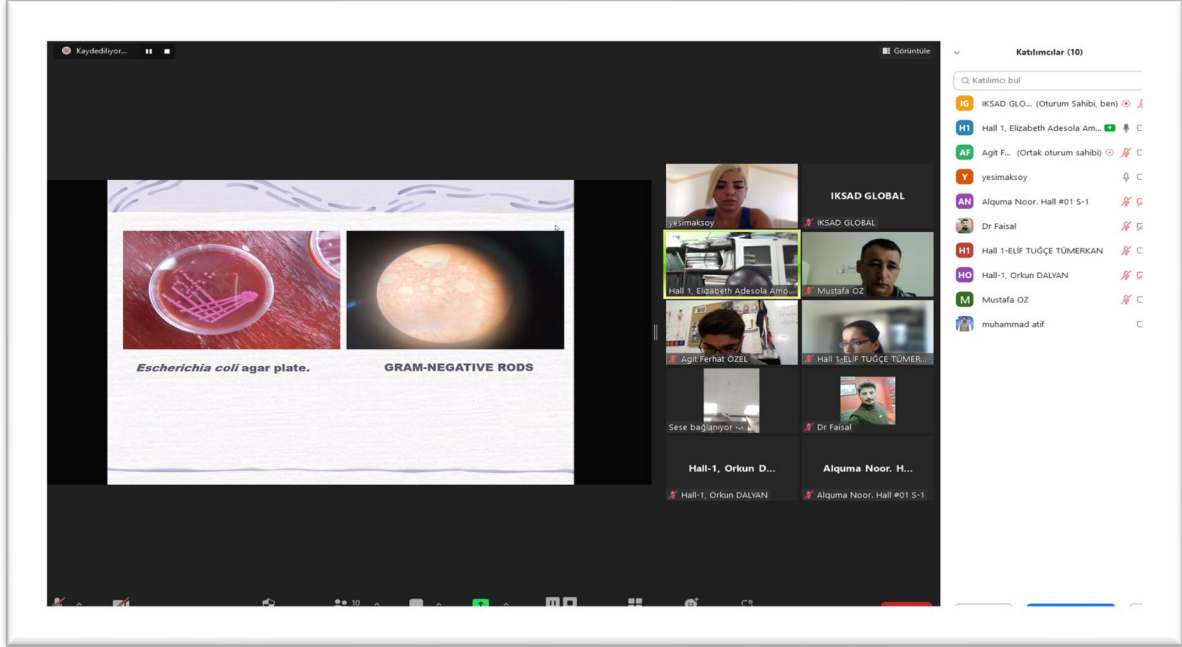
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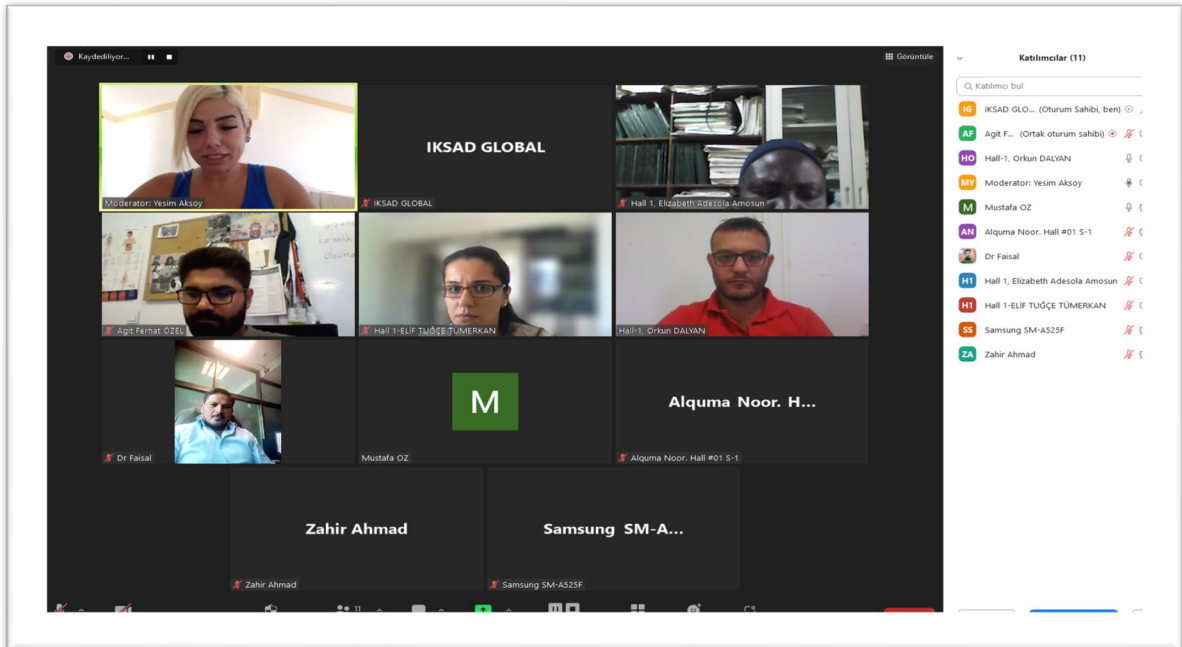
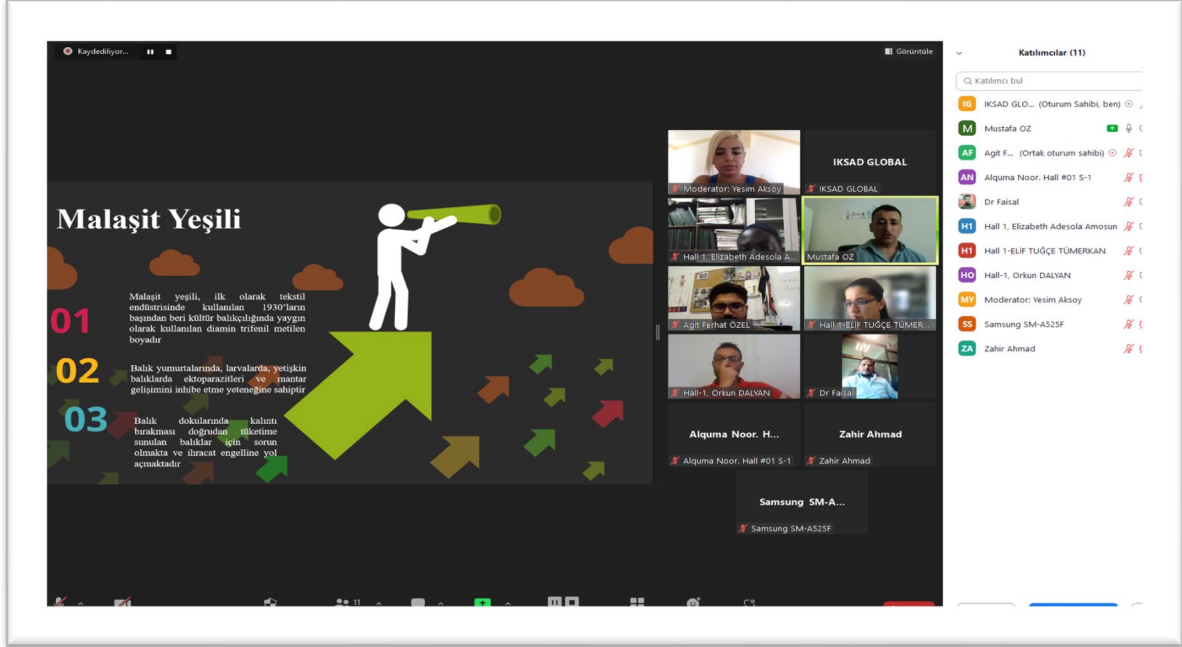


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# CAUSES AND PREVENTION OF FOOD SAFETY HAZARDS

Natalija ATANASOVA-PANCEVSKA

## ABSTRACT

Safety is an intrinsic quality attribute of foods and it is strictly related to their suitability for human consumption. It is recognised that a main role on food safety is played by microbial contamination and growth of pathogenic microorganisms as well as of presence of microbial/biological toxins that make raw materials and commodities as well as processed foods dangerous and may cause illnesses and infections with main impact on human health. However, food safety is a concept with a wider meaning and do not deals only on the actions to reduce microbial contamination but has to take into account other hazards that during handling, storing and preparing food may determine loss of nutrients making foods of low importance in our diet or cause the formation of unhealthy compounds.

Consumers have a right to expect that those who supply the food that they buy have taken every care to manufacture products that will do them no harm. Those with a responsibility for the regulation of the global food industry recognise this principle and legislate accordingly.

The three main types of food contaminants are physical, chemical and microbiological. Foods can become contaminated during growing and harvesting of raw materials, storage and transport to the factory and processing into finished products. Finished products may then be contaminated during subsequent storage and transport to retail display, as well as during storage and preparation by the consumer. The main vectors of contamination are through contact with surfaces (food contact surfaces and packaging), the air (or other gases), with water (or other liquids) or with people (or animals and insects). Hazards in the raw materials, packaging and the process are controlled by the HACCP plan with additional controls in the quality plan.

**Keywords** : hazard analysis critical control point (HACCP), hazard, contaminants, food safety .



**YEMEKHANE ÇALIŞANLARININ BİREYSEL HİJYEN DAVRANIŞLARI İLE COVID-19  
FARKINDALIĞI ARASINDAKİ İLİŞKİNİN İNCELENMESİ  
EXAMINATION OF THE RELATIONSHIP BETWEEN THE INDIVIDUAL HYGIENE  
BEHAVIORS OF DINING HALL EMPLOYEES AND COVID-19 AWARENESS**

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**ÖZET**

Günümüzde birçok işyeri çalışanlarının yemeklerini kendi bünyesinde yer alan yemekhanelerden karşılamaktadır. Çeşitli sektörlerde COVID-19 salgını için çeşitli araştırmalar gerçekleştirilmiştir. Ancak tehlikesi nispeten diğere bölümlere göre daha az olarak görülen işyeri yemekhane ve mutfak bölümleri üzerine COVID-19 çalışmaları son derece azdır.

Bu çalışmada, Çanakkale ilinde inşaat sektöründe faaliyet gösteren firmanın yemekhane bölümünde görevli personellerin tamamı (N=84) ile Hijyen Davranışlarını Belirleme Ölçeği (26 madde) ile COVID-19 Farkındalık Ölçeği (21 madde) kullanılarak araştırma çalışması gerçekleştirilmiştir. Ölçeklerin faktörleri belirlenerek faktörler arasındaki korelasyon incelenmiştir. Ayrıca yemekhane bölümünde görevli personellerin kişisel hijyen davranışları ve COVID-19 farkındalıklarının demografik özelliklere göre değişimi incelenmiştir. Anket verileri SPSS 24.0 programı ile analiz edilmiştir.

Analiz sonuçları incelendiğinde, her iki anket ifadeleri ve alt faktörler ile katılımcıların demografik özellikleri (cinsiyet, medeni durum, yaş, mesleki tecrübe ve görevi) arasında anlamlı bir farklılık tespit edilememiştir.

Hijyen Davranışlarını Belirleme Ölçeği analiz sonuçlarına göre en yüksek ortalamaya sahip ifade, "Çay molalarında ofislerin havalandırılmasına dikkat ederim" ( $\bar{X} = 4.38$ ), en düşük ortalamaya sahip ifade ise "İşyerinde lokale oturmadan önce masaları temiz bir bez veya ıslak mendille mutlaka temizlerim" ( $\bar{X} = 2,28$ ) dır.

COVID-19 Farkındalık Ölçeği analiz sonuçlarına göre en yüksek ortalamaya sahip ifade, "El hijyeni için tercih edilen en etkin yöntem, yaklaşık 20 saniye elleri sabunla iyice yıkamaktır" ( $\bar{X} = 4.28$ ), en düşük ortalamaya sahip ifade ise " Kapalı alanlarda (AVM, okul, vb.) kalabalık yerlerde insanlarla fiziksel mesafeye dikkat ederim" ( $\bar{X} = 2,03$ ) dır.

Pearson Korelasyonu analiz sonuçlarına göre, Hijyen Davranışlarını Belirleme Ölçeği ortalaması ile COVID-19 Farkındalık Ölçeği ortalaması arasında yüksek düzeyde, pozitif yönde ve anlamlı bir ilişki bulunmuştur.

Çalışma sonucunda elde edilecek bilgiler ile COVID-19 ve benzeri salgın hastalıkların engellenmesinde özellikle gıda sektöründe görevli personellerin hangi konularına öncelikle verilmesi gerektiği belirlenebilecektir.

**Anahtar Sözcükler:** COVID-19, Çanakkale, Kişisel Hijyen, Yemekhane Çalışanları

**ABSTRACT**

Today, many workplaces meet the meals of their employees from their own dining halls. Various studies have been carried out in various sectors for the COVID-19 outbreak. However, there are very few COVID-19 studies on the workplace dining hall and kitchen sections, which are seen as relatively less dangerous than other departments.

In this study, a research study was carried out by using the Hygiene Behavior Scale (26 items) and the COVID-19 Awareness Scale (21 items) with all of the personnel (N=84) working in the cafeteria section of the company operating in the construction sector in Çanakkale. The factors of the scales were determined and the correlation between the factors was examined. In addition, the personal hygiene behaviors of the personnel working in the cafeteria department and the change of COVID-19 awareness according to demographic characteristics were examined. Survey data were analyzed with SPSS 24.0 program.

When the results of the analysis were examined, no significant difference could be detected between both questionnaire expressions and sub-factors and the demographic characteristics of the participants (gender, marital status, age, professional experience and duty).

According to the Hygiene Behaviors Determination Scale analysis results, the expression with the highest average is "I pay attention to the ventilation of the offices during tea breaks" ( $\bar{X} = 4.38$ ), while the expression with the lowest average is "I always clean the tables with a clean cloth or wet wipes before I sit in the cafeteria" ( $\bar{X} = 2.28$ ).

According to the COVID-19 Awareness Scale analysis results, the expression with the highest average is "The most effective method preferred for hand hygiene is to wash hands thoroughly with soap for about 20 seconds" ( $\bar{X} = 4.28$ ), while the expression with the lowest average is "In closed areas (AVM, I pay attention to physical distance with people in crowded places (school, etc.)" ( $\bar{X} = 2.03$ ).

According to the results of Pearson Correlation analysis, a high, positive and significant relationship was found between the mean of the Hygiene Behaviors Determination Scale and the mean of the COVID-19 Awareness Scale.

With the information to be obtained as a result of the study, it will be possible to determine which subjects should be given priority to the personnel working in the food sector, especially in the prevention of COVID-19 and similar epidemic diseases.

**Keywords:** COVID-19, Çanakkale, Personal Hygiene, Dining Hall Staff

# KUZHEY KIBRIS'TA İNSANLARIN KORONA VİRÜS'TEN KORUNMAYA YÖNELİK HİJYEN VE KİŞİSEL BAKIM AÇISINDAN FARKINDALIK DÜZEYLERİNİN İNCELENMESİ LEVELS OF AWARENESS OF PEOPLE IN TERMS OF HYGIENE AND PERSONAL CARE FOR PROTECTION AGAINST THE CORONAVIRUS: NORTH CYPRUS CASE

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## ÖZET

İlk olarak Çin'in Wuhan eyaletinde ortaya çıkan ve Ocak 2020 itibariyle tanımlanan Yeni Tip Koronavirüs (Covid-19) salgını üç ay gibi kısa bir süre içerisinde tüm dünyayı etkisi altına almıştır. Dünyada hızla yayılmasıyla birlikte Dünya Sağlık Örgütü (WHO) 11 Mart 2020'de Yeni Tip Koronavirüsü (Covid-19) küresel salgın anlamına gelen pandemi olarak ilan etmiştir. Aynı zamanda bu tarihte Kuzey Kıbrıs'ta ilk olarak Covid-19 vakası görülmüştür.

Koronavirüsün, insandan insana; konuşma, hapşırma ya da öksürmeyle birlikte dışarı çıkan küçük damlacıklar yoluyla bulaştığı bilinmektedir. Semptom gösteren veya göstermeyen hasta bireylerden dağılan bu damlacıkların bulunduğu yüzeye temas eden sağlıklı bireylere virüs, ağız, burun veya göz mukozası yoluyla bulaşmaktadır. Ayrıca hasta bireylerden dışarı çıkan bu damlacıkları soluyan sağlıklı bireylerin de hastalandığı bilinmektedir. Kişilerin ne kadar süreyle taşıyıcı olduklarına dair kesin bir veri bulunmamakla birlikte; hiçbir belirti göstermeyen kişilerin de virüsü yaydığı gözlemlenmiştir.

Bu araştırmada, Kuzey Kıbrıs'ta insanların korona virüs'ten korunmaya yönelik hijyen ve kişisel bakım açısından farkındalık düzeylerine ilişkin görüşlerini belirlemek amaçlanmıştır. Araştırma, betimsel niteliktedir. Araştırmada genel tarama modeline uygun olarak araştırmacılar tarafından hazırlanan anket aracılığıyla veri toplanmıştır. Araştırmada basit rastgele örnekleme temel alınarak Kuzey Kıbrıs'ta farklı ilçelerde yaşayan 439 kişiye ulaşılmıştır. Verileri çözümlmek için frekans ve yüzdeler gibi betimsel istatistiklerden yararlanılmıştır. Araştırmanın bulgularına göre katılımcıların Covid-19 pandemisinden korunmak için insanlarla yakın temasta bulunmamaya özen gösterdikleri, ellerini tuvalet ziyaretinden sonra yıkadıkları, evlerini sık sık havalandırdıkları, insanlarla aralarındaki bir metrelik mesafeyi korudukları, ellerini su ve sabun ile yıkadıkları, Covid-19 pandemisi ile ilgili kişisel bakım ve hijyenle ilgili bilgileri en sık takip ettikleri kitle iletişim aracının televizyon olduğu görülmüştür.

**Anahtar Kelimeler:** Covid-19, Hijyen, Kişisel Hijyen, Kişisel bakım, Kuzey Kıbrıs

## ABSTRACT

The outbreak of the New Type of Coronavirus (COVID-19) which initially emerged in the Chinese city of Wuhan and which was defined by January 2020 has taken the world by Public Health Emergency of International Concern within a time period as short as three months. Following its rapid global spread, the World Health Organization (WHO) declared the New Type of Coronavirus (COVID-19) a pandemic on 11 March 2020, which meant that it was a global outbreak. Similarly, on the same date, the first COVID-19 case was reported in North Cyprus.

It is known that the coronavirus is transmitted from human to human through respiratory droplets exhaled during speech, cough or sneeze. Healthy people contract the virus through the mouth, nose or eye mucus when they contact surfaces containing these droplets spread by symptomatic or asymptomatic infected people. It is also known that healthy people inhaling these droplets exhaled by infected people are infected. Although the duration people can carry the disease is not definitely known, it has been observed that asymptomatic people also transmit the virus.

The present research, which is descriptive aims to ascertain the views of the people in North Cyprus in relation to their levels of awareness in terms of hygiene and personal care for protection against the coronavirus. Data for the research were collected through the online survey prepared for the researchers in line with the quantitative research approach. On the basis of simple random sampling, 439 people living in different districts in North Cyprus were reached. Descriptive statistics such as frequency and percentage were used for data analysis. Research findings revealed that participants pay attention to not having close contact with other people for protection against the COVID-19 pandemic, wash their hands after visiting the toilet, keep a

distance of one meter with other people and that television is the mass medium through which they follow information on personal care and hygiene related to COVID-19 pandemic most frequently.

**Keywords:** COVID-19, Hygiene, Personal hygiene, Personal care, North Cyprus



# PERCEPTION OF DOMESTIC FOOD HYGIENE IN THE DISTRICT OF GODOMEY IN BENIN

Séraphin MOUZOUN

## ABSTRACT

Hygiene is the set of means aimed at keeping human beings in good health by protecting them against diseases. In a broader sense, it consists in controlling the environmental factors that can alter health: pollutants, hormonal disruptors, allergens, factors of societal and climatic changes. Foodborne illnesses (FBDs) are a real scourge for communities around the world. Admittedly, collective catering is still a major provider of these conditions, however an increase in family cases has been observed almost everywhere in the world.

The family environment is often implicated in the occurrence of collective food poisoning. This is why it was deemed necessary to initiate a reflection to assess the perception of domestic food hygiene by women. The survey was carried out among women residing in Godomey. A total of 50 women were interviewed using a questionnaire.

The results revealed familiarity with MOAs by 45.5% of the interviewees. Indeed, 71.5% of women recognize the main cause of MOA (germs) and 89.5% of them mention diarrhea as the main MOA. Summer is recognized as a season of resurgence of MOAs by 87.3% of those interviewed. The family environment was only recognized as a provider of MOAs by 16.5% of the respondents. In addition, a lack of knowledge of certain perishable food products was noted, requiring special attention during procurement. The use of bleach at home, although common practice, does not seem to cover all its indications for use. The disinfection of raw vegetables is only practiced by 33.4% of the interviewees, while the disinfection of eggs is mentioned by only 6.8% of the women. 67.7% of the interviewees acknowledge that they only partially master the rules of food hygiene and express a need for information in this area. The results of our study should be used for reflection on the strategy of promoting domestic food hygiene.

**Keywords:** Foodborne diseases, food hygiene, hygiene

# CEFOTAXIME RESISTANT AND EXTENDED-SPECTRUM $\beta$ -LACTAMASE-PRODUCING *ENTEROBACTERIACEAE* FROM CHICKEN MEAT IN IBADAN, NIGERIA

Elizabeth Adesola AMOSUN  
Qasim Mobolaji AJIBOLA

## ABSTRACT

**Introduction:** Production of extended-spectrum  $\beta$ -lactamases (ESBLs) confer resistance to  $\beta$ -lactam antibiotics especially penicillin, monobactams as well as old and new generations of cephalosporin.

This study examined the presence of cefotaxime-resistant and Extended-spectrum  $\beta$ -lactamase producing enterobacteriaceae in chicken meat production chain in Ibadan, Oyo- State, Nigeria.

**Methods:** A total of 128 chicken meats were purchased from different markets in Ibadan, Oyo-State. Seven local Government area were sampled. The meat samples were put in peptone water and incubated for 24 hours at 37°C. The broth cultures were then plated on MacConkey agar supplemented with ampicillin at a concentration of 100mg/L incubated for 24 hours at 37°C. All ampicillin resistant isolates were cultured on MacConkey agar plates supplemented with 1mg/L of cefotaxime. All cefotaxime-resistant isolates were identified biochemically using Microbact test kit GNB 24E (Oxoid<sup>R</sup>) and the results interpreted by a computer aided software. ESBL producers were confirmed by double disc synergy method using cefpodoxime and cefpodoxime/clavulanic acid combination disc kit.

**Results:** Out of 128 samples 8 (6.25%) were confirmed to be ESBL producers and biochemically identified to be *Escherichia coli*. Overall, cefotaxime-resistant bacteria were detected in 54 (42.19%) out of 128 samples. Cefotaxime-resistant isolates were identified as *Escherichia coli* (n=20), *Klebsiella spp* (n=16), *Enterobacter aerogenes* (n=3) and *Pseudomonase aeruginosa* (n=15). All cefotaxime-resistant isolates were multidrug resistant with resistance to at least one antimicrobial agent from seven different classes of antimicrobials used.

**Conclusion:** The increasing prevalence of antibiotic resistance is an important problem in developing countries where there is limited control and surveillance of the quality, sales and administration of antibiotics in human, veterinary medicine and even in food-animal agriculture. Therefore, antimicrobial resistant bacteria can enter the meat production chain from carrier animals and get transmitted to humans.

**Keywords:** cefotaxime Resistant, extended-spectrum  $\beta$ -lactamase, chicken meat, *enterobacteriaceae*, Chicken meat, Ibadan, Nigeria

# MINERAL AND GEOCHEMICAL COMPARISON OF THE CLAY OF DIBIS AND LAYLAN QUARRIES - KIRKUK GOVERNORATE – IRAQ

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## ABSTRACT

In this study, a geochemical and mineral evaluation of the Anjana formation clay was conducted in selected areas of Kirkuk Governorate in the northern part of Iraq as raw materials in the manufacture of kilns, (10) samples were collected from two locations, the first location (Laylan) with (5) samples and the second location (Dibis) with another (5) samples for the purpose of conducting various tests on them represented by geochemical and mineral tests.

As the study of geochemical specifications is represented by the concentration of elements and oxides (silica, aluminum oxide, and sulfates), organic content, gypsum content, and PH.

As for the mineral study, tests have relied upon X-Ray Diffraction (XRD), two groups of minerals have been distinguished, they are clay minerals (Kaolinite, Illite, Chlorite, Montmorillonite) and non-clay minerals (Quartz, Carbonate Minerals, Feldspar).

The research concluded that the two quarries have similar geochemical characteristics but differ in some oxides such as sulfate (SO<sub>3</sub>).

As for the mineral content, it is similar to both quarries. On this basis, the clays in the quarries can be used in local industries that depend on clays, such as the manufacture of kilns.

**Keywords:** Anjana Formation, Clay mineral, XRD, Manufacture of kilns, Laylan clay quarry, Dibis clay quarry

# **FLUCTUATING YOUR BODY VICISSITUDES EATING PERSPECTIVES ENCAPSULATION OF A THIN SIMULATED FIGURE GOADS EVASION OF UNWHOLESOME FOOD**

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## **ABSTRACT**

Artificial Intelligence already working on lots of probs and cons, reality full body deception worldview has been recommended to not just trigger the fanciful responsibility for symbol's body yet in addition the attitudinal and social parts characteristically related to that sort of virtual body. In the current review, we researched whether this was valid for generalizations connected with body size: body fulfillment and eating control conduct. Solid members went through the full-body deception worldview with a symbol having either a bigger or a slimmer body than their own, and were surveyed for implied perspectives towards self-perception and food calorie content at standard and after each full-body deception meeting. Results showed that the deception arose no matter what the symbol's body size, while the apparent element of the own body size changed by the symbol's body size (i.e., members felt to be slimmer in the wake of exemplifying their thin symbol and bigger subsequent to encapsulating their enormous symbol). Urgently, we tracked down that implied mentalities towards food, yet not those towards one's own body, were tweaked by the size of the virtual body. Contrasted with standard, responsibility for slimmer symbol expanded the evasion of fatty food, though responsibility for bigger symbol didn't actuate changes. Our discoveries recommend that the fanciful sensation of being slimmer drives additionally the food-related generalizations related with that body size, expanding the guideline of eating ways of behaving.

**Keywords:** probs and cons, deception, trigger, characteristically, worldview, tweaked



## **EFFECT OF HYGIENE ON PERFORMANCE CHARACTERISTICS OF BROILER BIRDS**

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**Salami M.O**  
**Dagba B.I**  
**Atteh M.O.**

### **ABSTRACT**

About one hundred and fifty (150), Ross broiler chicks was used in a six (6) week experiment to investigate the effect of hygiene on performance characteristics of broiler birds, there are three (3) treatments and each containing fifty (50) birds each in a pen, the birds in each pens are fed same diet and follow the same drug and vaccine programme but the pen with first fifty (50) birds had all the hygiene been observed throughout the experiment, the next pen containing the second fifty (50) birds has few of the hygiene been observed while the last pen containing the last fifty (50) birds has non hygiene observed throughout the period of the experiment. At the end of the experiment, the first pen had only one (1) chick mortality, the second pen has ten (10) birds mortality while the last pen has about forty one (41) and it occurred at all weeks of the experiment, this account for about 2%, 20% and 82% respectively in all the three (3) pens, therefore hygiene is a must in poultry house.

**Keywords :** Diet, pen, treatments and hygiene

# SMART ANTIFUNGAL DRUG DELIVERY SYSTEM: IN VITRO RELEASE, PHARMACOKINETICS AND SAFETY STUDY

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## ABSTRACT

Fluconazole (FCZ) is a broad spectrum anti-fungal drug and categorized as a BCS class-I molecule because of its readily soluble and highly permeable properties. Oral delivery of FCZ is associated with teratogenic effects. Thus, other routes of administration needs to be investigated for improved efficacy of the drug. The purpose of this study was to prepare and characterize FCZ loaded thermosensitive system (FCZ-TSS) for rectal administration with sustained release and improved bioavailability. The ingredients of FCZ-TSS were optimised by preparing different formulations using various concentrations of Poloxamer 407 (P-407), Poloxamer 188 (P-188), Tween 80 (Tw-80) and FCZ. The FCZ-TSS was liquid at room temperature and converted into gel at body temperature. The rheological properties of the FCZ-TSS were determined including, gelation temperature, gel strength, gelation time and mucoadhesive force. In vitro release and in vivo pharmacokinetic studies of the optimised formulation was performed and compared with the drug solution. P-407 and Tw-80 reduced the gelation time and gelation temperature of FCZ-TSS, but increased the mucoadhesive force and gel strength. Optimised FCZ-TSS was liquid at room temperature which upon increase in temperature converted into gel at approximately 30.16 °C. The gel formation took around 1.23 min and exhibited its easy administration and quick gelation inside the body. FCZ-TSS released the drug over a time period of 24 hrs, displaying sustained behaviour as compared with the drug solution which take only 4 hrs for complete release of the drug. Moreover, the higher C<sub>max</sub> and AUC values of FCZ-TSS as compared to FCZ solution showed increased bioavailability of FCZ. Furthermore, in vivo safety study demonstrated safe profile of FCZ-TSS when compared with FCZ solution, after their application to rectal mucosa. These results confirmed that TSS has the potential to improve the bioavailability of FCZ with increased safety.

**Keywords:** Fluconazole, Thermosensitive System, Anti-Fungal Agent, Fungal Infections, Rectal Route, Poloxamers.

# BALIK ÇİFTLİKLERİNDE KONTAMİNASYONA NEDEN OLAN ETMENLER FACTORS CAUSING CONTAMINATION IN FISH FARMS

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## ÖZET

Su ürünleri sektörü hem dünyada hem de Türkiye’de en hızlı büyüyen sektörlerin başında gelmektedir. TÜİK verilerine göre 2021 yılında su ürünleri yetiştiriciliği 2020 yılına göre yaklaşık %11,9 oranında artmıştır. COVID-19 salgınının tüm sektörlerde üretimin azalmasına neden olurken su ürünleri sektörü pandemiye rağmen büyümeye devam etmiştir. Yetiştiricilik sektöründeki büyümenin sürdürülebilir olması için çiftliklerdeki balık ölümlerinin de minimuma indirilmesi gerekmektedir. Balık çiftliklerinde bireysel ölümden ziyade sürü bazında ölümler görülmektedir. Bundan dolayı kontaminasyonu önlemedeki en etkili yöntem, kontaminasyon sebepleri tespit edilip koruyucu önlemler alınmalıdır. Kontaminasyona sebep olan birçok faktör bulunmaktadır. Bunlardan bazıları çiftlikler de kullanılan aletler ve ekipmanlar, personel, böcekler, kuşlar, kemirgenler, su ve yem gibi birçok faktör kontaminasyona neden olmaktadır. Bu gibi faktörler balık çiftliklerinde hastalığın ortaya çıkması ve yayılmasında rol oynamaktadır. Alet ekipman, personel gibi faktörlerle genellikle viral ve bakteriyel etkenler kontaminasyon oluşturmaktadır. Böcek, kuş ve kemirgen gibi etmenler genellikle paraziter etkenler kontaminasyona sebep olmaktadır. Kültürü yapılan balık çiftliklerinde balıkların toplu halde bulunmasından dolayı deniz, göl ve barajlarda yaşayan balıklara göre kayıplar daha fazla olmaktadır. Bundan dolayı konak, çevre ve etken arasındaki etkileşim bizim için önemli olmaktadır. Bu etkileşim de etken ve konak faktörlerini kontrol altına almak zor olacağından çevre faktörünü kontrol altına almak önemli olmaktadır. Sonuç olarak; dünyanın en ve ülkemizin en hızlı büyüyen gıda sektörlerinden birisi olan su ürünleri yetiştiricilik sektörünün büyümesini sağlıklı bir şekilde sürdürebilmesi için çiftliklerdeki kontaminasyon sebeplerinin belirlenmesi ve ortadan kaldırılması oldukça önemlidir.

**Anahtar Kelimeler:** Balık çiftliği, Kontaminasyon, Korunma

## ABSTRACT

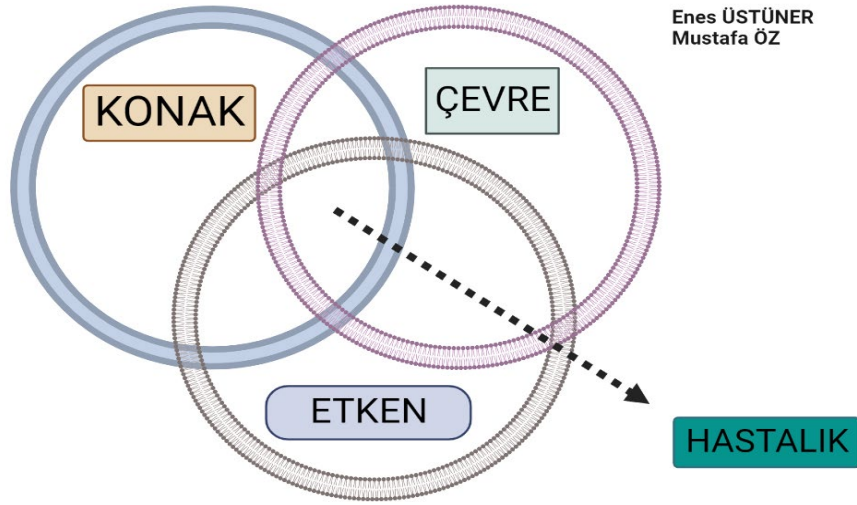
The aquaculture sector is one of the fastest growing sectors both in the world and in Turkey. According to TUIK data, aquaculture increased by 11.9% in 2021 compared to 2020. While the COVID-19 outbreak caused a decrease in production in all sectors, the aquaculture sector continued to grow despite the pandemic. In order for the growth in the aquaculture sector to be sustainable, fish deaths in farms must also be minimized. Deaths in fish farms are seen on a flock basis rather than individual deaths. For this reason, the most effective method of preventing contamination is to determine the causes of contamination and to take protective measures. There are many factors that cause contamination. Some of these factors cause contamination such as tools and equipment used in farms, personnel, insects, birds, rodents, water and feed. Such factors play a role in the emergence and spread of the disease in fish farms. Viral and bacterial factors generally cause contamination with factors such as tools, equipment and personnel. Factors such as insects, birds and rodents usually cause contamination by parasitic factors. Due to the mass presence of fish in cultured fish farms, losses are higher than fish living in seas, lakes and dams. Therefore, the interaction between the host environment and the agent is important for us. It is important to control the environmental factor since it will be difficult to control the factor and host factors in this interaction. As a result; In order for the aquaculture sector, which is one of the fastest growing food sectors in the world and in our country, to sustain its growth in a healthy way, it is very important to determine and eliminate the causes of contamination in farms.

**Keywords:** Fish farm, Contamination, Protection

## GİRİŞ

Su ürünleri yetiştiricilik sektörü hem Dünyada hem de Ülkemizde uzun yıllardan beri en hızlı büyüyen gıda sektörlerinden birisidir. Su ürünleri yetiştiriciliğinden elde edilen balıklar artan dünya nüfusu ve tüketici

bilinciyle birlikte ortaya çıkan sağlıklı gıdaya erişim probleminin çözümünde en önemli kanallarından birisi olmuştur (Öz ve Üstüner, 2021). Ülkemiz ise su ürünleri yetiştiriciliğinde oldukça iyi bir konumda bulunmaktadır. COVID-19 pandemisi tüm sektörleri etkilemiş, büyümede azalmaya ve bazı sektörlerde ise üretimi durma noktasına getirmiştir. Ülkemizde ise su ürünleri sektörü pandemiye rağmen büyümesine devam etmiştir. Kontaminasyon ise hastalıkların çiftliklere taşınmasında büyük bir faktördür. Kontaminasyon yollarına baktığımızda ham madde, personel, su ve taşıyıcılar önemli olmaktadır. Bu yollar ile viral, bakteriyel, paraziter ve mantar kaynaklı birçok hastalık balıklara bulaşmaktadır. Konak, etken ve çevre üçgeni bulaşmada önemli rol oynamaktadır. Kontaminasyon engellenirse bu üçgen arasındaki bağ kırılıp hastalıkların oluşmasının önüne geçilir. Etken konak çevre üçlüsü şekil 1’de verilmiştir. Kontaminasyonu önlemedeki etkili yöntem, kontaminasyon sebepleri tespit edilip koruyucu önlemler alınmalıdır.



Şekil 1. Hastalıkların ortaya çıkmasında önemli olan konak, çevre ve etken üçlüsü

## Kontaminasyona Neden Olan Faktörler

### Balık Yemi

İnsanoğlu ilk zamanlar doğada kendiliğinden yetişen yem niteliğinde olabilecek materyalleri kullanmaya başlayıp, ilerleyen zamanlarda bilimin gelişmesiyle alternatif yem kaynakları aramaya ve yemlerin işlenmesine yönelik teknolojiyi kullanmaya başlamıştır (Budağ, 2011). Yemin hijyenik olması sadece balıklar için değil aynı zamanda balıkları tüketen insanlar için de önemli olmaktadır. Yemin besin içeriğinin kaliteli olmasının yanında mikrobiyolojik ve mikotoksin bulunmaması da yemin hijyeni açısından önemli olmaktadır (Basmacıoğlu ve Ergül, 2003). Yem hijyenini etkileyen en büyük sorunlardan biri mikotoksinler olmaktadır. Mikotoksinler filamentli mantarlar olan en yaygın *Aspergillus*, *Penicillium* ve *Fusarium* cinslerinin türleri tarafından ikincil metabolitler olarak üretilen doğal olarak oluşan moleküllerdir (Bennett ve Klich, 2003). Yemde veya ham maddelerde bu tür mantarların bulunması mikotoksinlerin olacağı anlamına gelmemektedir. Hijyen açısından bu tür suşların nem içeriği, havalandırma, sıcaklık ve diğer saklama koşulları gibi çeşitli faktörler bu toksik metabolitlerin üretimini etkiler, genellikle sıcak ve nemli koşullar mantar büyümesine ve toksin üretimine yol açan iki ana faktördür (Saad, 2016). Mikotoksinler tarafından kontaminasyon, su ürünlerinde besin değerinde bozulmaya hem balıklar için hem de insanlar için önemli bir sağlık riski oluşturmaktadır (Oliveira ve Vasconcelos, 2020). Mikotoksikoz, bir veya daha fazla mikotoksinin organizmaya alınmasıyla balıklarda ve insanlarda ölümle sonuçlanabilen zehirlenmelerdir (Krogh, 1969). Kronik mikotoksikoz, düşük dozda mikotoksine maruz kaldıktan sonra kanser oluşumu, bozulmuş büyüme ve immün disfonksiyon meydana gelmektedir (Roberts vd., 2022). Mikrobiyal bulaşma engellenemediği toksin oluşumu kontrol altına alınamadığı durumlarda yemden mikroorganizmaların ve toksinlerin uzaklaştırılması gerekmektedir (Basmacıoğlu ve Ergül, 2003). Yemlere katkı maddeleri olarak inorganik ve organik maddelerin katılması etkili sonuçlar elde edildiği görülmüştür (Smith vd., 2001).

### Personel

Mikroorganizmaların personel tarafından özellikle ellerle taşınması önemli olmaktadır (Chen vd., 2001). Taşıma ve hazırlama sırasında bakteriler gıda çalışanlarının ellerinden gıdaya ve sonrasında diğer yüzeylere aktarılmaktadır (Montville vd., 2002). *Staphylococcus Aureus* ürettiği toksinler dış etkenlere karşı dirençli olduğu için kişisel hijyen kurallarına uyulması gerekmektedir (Murat ve Doğan, 2020). Shigella ve patojenik *Escherichia coli* gibi mikroorganizmaların düşük dozları kontaminasyon kaynağı olarak ellerle ilişkilendirebilir (Snyder, 1998). Kötü hijyen özellikle yetersiz ve el yıkamanın olmaması bulaşmadaki önemli nedenlerden biri olmaktadır (Reij vd., 2004). Uygun bir şekilde elin yıkanması ve dezenfeksiyonun yapılması hasta kişilerin tespit edilip kısıtlanması patojenlerin yayılmasının kontrol edilmesinde en etkili yöntemlerden biri olmuştur (Montville vd., 2001).

### **Ekipmanlar**

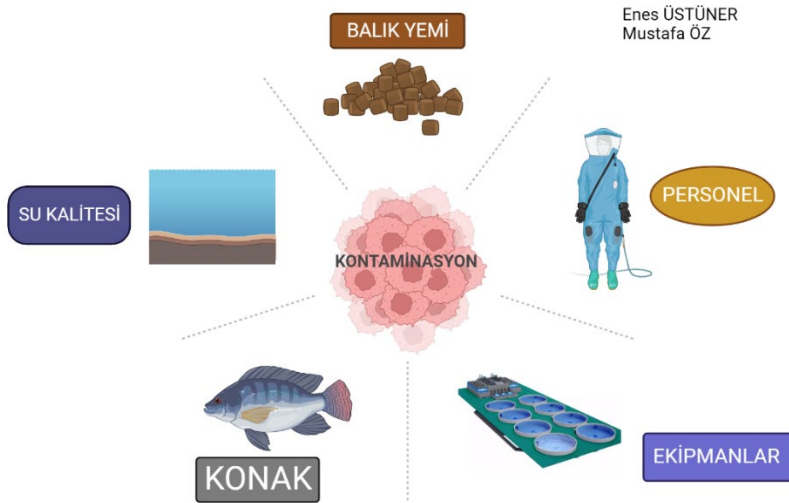
Tüm üretim aşamalarında balıkla temas eden yüzeylerin kötü hijyen süreci ürün kalitesini etkileyen önemli bir faktördür (Temelli vd., 2006). Doğru bir hijyen prosedürü ile uzaklaştırılamayan kir partikülleri ve mikroorganizmalar yüzeye yapışıp ve mikroorganizmalar için biyofilm oluşumuna neden olmaktadır (Salustiano vd., 2010). Ekipmanların mikroorganizma kontaminasyonu, gıda endüstrisinde bir risk faktörüdür. Bundan dolayı yapıldıkları malzeme seçimi ve korozyon önleyici özellikte olması hijyeni kolay olmalıdır (Fuster-Valls vd., 2008).

### **Su**

Balık çiftliklerinde su parametrelerinde değişiklikler patojen mikroorganizmalar olsun yada olmasın suyun mikrobiyom dinamiklerini doğrudan etkilemektedir (Jahangiri vd., 2021). Su ortamları birbiriyle ve konakçıyla sürekli etkileşime giren oldukça fazla mikroorganizma içermektedir (Fernandez vd., 2019). Su kalitesindeki değişiklikler kirlilik, iklim değişikliği ve ortamdaki patojenik mikroorganizmaların çoğalması gibi faktörler yer almaktadır (Jahangiri vd., 2021). Enfeksiyonlarla çevresel faktörler güçlü bir şekilde bağlantılı olmaktadır (Hennersdorf vd., 2016). Bir başka kontaminasyon kaynağı su kaynaklarının kirletilmesi olmaktadır. Büyük miktarlarda evsel atık su ve endüstriyel atıklar nehirler tarafından taşınmakta ve denizlere boşalarak kirletmektedir. Bu tür antropojenik kirleticiler, denizler ve iç suların ana kirletici kaynağıdır. Sucul sistemlerdeki metal kirleticiler genellikle ya çözünür ya da süspansiyon halinde çökerek organizmalar tarafından alınmaktadır (Das vd., 2007). Ağır metal kontaminasyonu, ortamın ekolojik dengesi ve çeşitli su organizmaları üzerinde yıkıcı etkiye sahip olmaktadır (Vosyliene ve Jankaitė, 2006). Böylece balıklarda metallerin birikmesi halk sağlığı açısından sorun oluşturmaktadır. Belirli dönemlerde su örnekleri alınarak analizler yapılmalıdır.

### **Balık**

Birçok patojenik bakteri, su ortamlarında (*Clostridium botulinum* tip E, *Vibrio* sp, *Aeromona* sp vb.) genelde çevrede (*C.botulinum* tip A ve *Listeria monocytogenes*) ise doğal olarak bulunmaktadır (Huss vd., 2000). Diğer mikroorganizmalar (*Salmonella*, *Shigella*, *E.coli* vb) hayvan ve insan rezervuarına aittir (Huss vd., 2000). Bundan dolayı üretim ve işleme sırasında bu mikroorganizmaların balıklarda bulunmamasına rağmen balıklara geçme olasılığı her zaman bulunmaktadır (Samakupa vd., 2003). Genel olarak, sağlıklı bir balık yakalandığında bağışıklık sistemi bakterilerin kolayca çoğalmasını engellediği için eti sterildir. Balığın ölümünden sonra bağışıklık sistemi inaktif olduğundan mikroorganizmalar ete kolayca geçmesine izin vermektedir. Kontaminasyona neden olan faktörler şekil 2 de gösterilmiştir.



Şekil 2. Balık çiftliklerinde kontaminasyona neden olan faktörler

## SONUÇ

Kontaminasyon meydana gelmesinde üç faktör bizim için önemli bunlar; konak, etken ve çevredir. Konak ve etken kontrol altına alınması zor olacağı için çevre şartlarını kontrol altına almak hem kontaminasyonu hem de hastalıkların bulaşmasını engelleyecektir. Koruma ve kontrol için alınacak önlemler; çevresel koşullar düzeltilmeli, konakçının immün sistemi güçlendirilmeli ve genetik direnci artırılmış türler üretilmeli, patojenlerle kontaminasyon olmuşsa kontaminasyonu gidermek için uygun kimyasal maddeler ve antibiyogram sonucuna göre uygun antibiyotik kullanılması, yemlerin kaliteli üretim aşamalarından geçmiş ve uygun koşullarda saklanması, patojenle kontaminasyon olmuş konakçı arasındaki ilişkinin kesilmesi gerekmektedir.

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# BALIK ÇİFTLİKLERİNDE KULLANILAN DEZENFEKTANLAR DISINFECTANTS USED IN FISH FARMS

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## ÖZET

Balık patojenleri, su ürünleri yetiştiricilik sektöründe çok yüksek ekonomik kayıplara sebep olmakta olup ve kontrol altına alınabilmeleri için ise antimikrobiyallerin kullanılması gerekmektedir. Çiftliklerde tedavi ve koruma amaçlı olarak birçok dezenfektan kullanılmaktadır. Bu çalışmanın amacı, balık çiftliklerinde kullanılan dezenfektanların hangi aşamada ve ne amaçla kullanılması gerektiği konularına açıklık getirerek işletmelerin ekonomik kayıplarının azaltılmasına destek olmaktır. Su ürünleri yetiştiriciliğinde yüksek bir performansla ulaşabilmek için biyogüvenlik oldukça önemli bir konudur. İşletmede kullanılan ekipman, havuz, tank ve su kolonunda yaşayan çeşitli potansiyel patojenleri ortadan kaldırmak için bazı dezenfektanlar kullanmak gerekir. Su ürünleri yetiştiriciliğinde kullanılan antiseptik ajanların, balık sağlığı üzerinde maksimum faydayı sağlaması ve çevre üzerindeki minimum düzeyde etki bırakması kabul edilebilirliği açısından çok önemlidir. Hastalıklar ortaya çıktığında balık ölümlerinden dolayı maddi kayıpların ve tedavisi için ise ekstra giderler olmaktadır. Hastalıklar meydana geldikten sonra tedavi etmek yerine balıkları hastalıktan korumak hem daha ucuz hem de daha kolay olmaktadır. Balık çiftliklerinde kullanılan dezenfektanların farklı görevleri vardır. Bu dezenfektanların görevleri bilinmesi ve koruyucu olarak hangi aşamalarda kullanılacağını bilmek önemli olmaktadır. Örnek vermek gerekirse; klor gibi dezenfektanlar ucuz, geniş bakteri grubu ve bakteri sporlarına karşı kullanılırken, iyodofor (iyotlu bileşikler) dezenfektanlar spor ve bazı virüslere karşı daha az etkili olmaktadır. Balık çiftliklerinde uygulanma şekilleri de farklılık göstermektedir. Bazı dezenfektanlar kuluçkahanelerde bazıları ise balıklarda banyo tarzında uygulanabilmektedir. Sonuç olarak; ülkemiz ekonomisi açısından önemli bir yere sahip olan su ürünleri sektörünün sürdürülebilir olması için hastalıklara karşı koruyucu önlem alınması ve hastalıkların ortadan kaldırılması son derece önemli olmaktadır.

**Anahtar Kelimeler:** Balık çiftliği, Dezenfeksiyon, Dezenfektan

## ABSTRACT

Fish pathogens cause very high economic losses in the aquaculture sector and antimicrobials must be used to control them. Many disinfectants are used in farms for treatment and protection. The aim of this study is to support the reduction of economic losses of enterprises by clarifying at what stage and for what purpose disinfectants used in fish farms should be used. Biosecurity is a very important issue in order to achieve a high performance in aquaculture. It is necessary to use some disinfectants to eliminate various potential pathogens living in the equipment used in the business, pool, tank and water column. It is very important for the acceptability of antiseptic agents used in aquaculture to provide maximum benefit on fish health and minimal impact on the environment. When diseases occur, there are financial losses due to fish deaths and extra expenses for their treatment. It is both cheaper and easier to protect the fish from the disease instead of treating the diseases after they occur. Disinfectants used in fish farms have different functions. It is important to know the duties of these disinfectants and to know at what stages they will be used as a preservative. For example; While disinfectants such as chlorine are cheap, used against a wide range of bacteria and bacterial spores, iodophor (iodized compounds) disinfectants are less effective against spores and some viruses. The way they are applied in fish farms also differs. Some disinfectants can be applied in hatcheries, while others can be applied to fish as a bath. As a result; In order for the aquaculture sector, which has an important place in our country's economy, to be sustainable, it is extremely important to take preventive measures against diseases and to eliminate diseases.

**Keywords:** Fish farm, Disinfection, Disinfectant

## GİRİŞ

Su ürünleri işletmelerinde dezenfeksiyon hastalık yönetiminde yaygın olarak kullanılan işlemlerden biridir. Patojen mikroorganizmaların çoğu hijyen kurallarına uyularak kontrol altına alınabilmektedir. Balık çiftliklerinde hastalıklar ortaya çıktığında toplu şekilde ölümler meydana gelmektedir. Ölümler başladığında hem ölen balıkların maliyeti hem de tedavi masrafları işletme giderlerini artırmaktadır. Hastalıklar ortaya çıktığında tedavi etmek yerine koruma ve kontrol önemlerinin alınması hem daha kolay hem de daha ucuz olmaktadır. Hijyen uygulamaları koruma ve kontrolün başında gelmektedir (Anonim 2022a). Dezenfeksiyon, canlılarda hastalık yapan mikroorganizmaların ve virüslerin inaktif hale getirilmesi işlemidir. Dezenfektan ise dezenfeksiyon işleminde kullanılan maddelere denilmektedir (Anonim 2022b). Balık çiftliklerinde farklı dezenfektanlar üretimin farklı aşamalarında kullanılmaktadır. Su ürünleri yetiştiriciliğinde kullanılan antiseptik ajanların, balık sağlığı üzerinde maksimum faydayı sağlaması ve çevre üzerindeki minimum düzeyde etki bırakması kabul edilebilirliği açısından çok önemlidir. Dezenfeksiyon prosedürünün seçimi, dezenfekte edilecek malzemeye, tesislerin boyutuna ve ülkede yasal olarak mevcut olan ürünlere bağlı olmaktadır (Hill vd., 2013). Dezenfeksiyondan önce tüm yüzeyler iyice temizlenmelidir. Yüzeyin temizlenmesinde kullanılan deterjan, dezenfektanla uyumlu olmalıdır. Örnek vermek gerekirse iyodofor çözeltiler genellikle asidiktir, bu nedenle alkali olan beton üzerine kullanılmaz (Anonim 2022a). Organik maddenin varlığı çoğu dezenfektanın dezenfeksiyon kapasitesini azaltacağından, giriş suyunun filtrelenmesi gerekmektedir.

### Balık Çiftliklerinde Kullanılan Dezenfektanlar

#### Klor

Klor hem ucuz hem de çok yaygın kullanılan dezenfektanların başında gelmektedir. Klor sağlık tesislerinde, evlerde kullanılmakta ve düşük konsantrasyonda antimikrobiyal etki göstermektedir (Mangalappalli-Illathu ve Korber, 2006). Klor genellikle membran geçirgenliği üzerine etki etmekte ve hücre içine girerek sitoplazmanın yapısını bozmaktadır (Fazlara ve Ekhtelat, 2012). Yüksek konsantrasyonlarda bakteri sitoplazmasının koagülasyon yapısını bozarak etki etmektedir (To vd., 2002). Klor bazlı dezenfektanlar toksik olmayıp, leke bırakmaz ve dilüsyonları kokusuz, iyonik olmayan, amfolitik ve katyonik yüzey aktif maddelerle uyumludur. (Fazlara ve Ekhtelat, 2012). Klorun önemli özelliklerinden biri sert sulardan etkilenmemesidir. Balık çiftliklerinde havuzların klorlanması hastalık vektörlerin öldürülmesine yardımcı olur. Klorlama ayrıca, stoklamadan önce kuluçkahaneler ve karides havuzlarına verilen sudaki patojen mikroorganizmaları öldürmek için kullanılmaktadır.

#### İyodoforlar

İyodoforlar, iyot ve bir çözüldürücü madde içeren çözeltilerdir. Bu şekilde, çözelti içinde yavaş yavaş az miktarda iyot salınmaktadır. Yüksek alkali ortamlarda ise etkinliği azalmaktadır. İyodoforlar mikroorganizmaların hücre duvarı ve zarlarına nüfus ederek, DNA sentezini bozmakta fakat mikroorganizmaların biyofilm oluşumunu engellemede diğer dezenfektanlara nazaran daha az etkilidir (Chauret, 2014). Balık çiftliklerinde iyodoforlar ile yumurtaların dezenfeksiyonu patojenlerin azaltılması için 1970'lerden beri uygulanmaktadır (Fws, 2022). Yumurtaların dezenfeksiyonu somon balıklarına yönelik olsa da yumurtalara buluşan patojen mikroorganizmalara karşı iyodoforla dezenfeksiyon mersin balığı, orfoz ve halibut gibi çeşitli kemikli balıklarda yaşam oranını arttırdığı bildirilmiştir. (Bergh ve Jelmert, 1996; Bouchard III ve Aloisi, 2002; Tendencia, 2001). İyodoforlar genellikle diğer dezenfektanlara göre daha az toksiktir fakat yüzeylerde sarı bir leke bırakabilmektedir.

#### Kuaterner Amonyum Bileşikleri (QAB)

Genellikle kokusuz, renksiz ve tahriş edici özellikte olmayıp fakat yutulduğunda oldukça toksik olmaktadır. Gram pozitif, gram negatif bakterilere ve zarflı virüslere karşı etkili ancak zarfsız virüslere ve bakteri sporlarına karşı etkili değildir (Monsey ve Devaney, 2011). Yüzeylere uygulandığında bakteri üremesini engelleyen bakteriyostatik film oluşturmaktadırlar (Flick, 1998). QAB bileşiklerinin aktivasyon mekanizması, enerji üreten enzimlerin yok edilmesi, önemli proteinlerin denatüre edilmesi ve hücre zarının yapısını bozarak etki etmektedir (Mon-On vd., 2018). QAB diğer dezenfektanlara göre çok az toksiktir (Wild, 2017). QAB bileşiklerinin etkinliği sert sularda ve anyonik dezenfektanlarla azalmaktadır (Plan, 2008; Wild, 2017). Kuaterner amonyum bileşikleri kuluçkahanelerde ve çiftliklerde larvalar, tanklar, havuzlar ve diğer ekipmanları dezenfekte etmek için kullanılır. Yapılan çalışmalarda balık çiftliklerinde görülen patojen mikroorganizmalardan *Vibrio sp*, *Edwardsiella tarda*, *Streptococcus sp.*, *Styphyllococcus sp.*, inhibe ettiği

bulunmuştur (Kim vd., 2008). Sadece balıklarda değil yapılan bir çalışmada istiridyelerin viral bir hastalığı olan Ostreid herpesvirus-1 (OsHV-1) karşı 10 dakika boyunca 2000 ppm'de uygulandığında %100 oranında etkili olduğu ortaya konulmuştur (Hick vd., 2016).

### **Formol (Formaldehit Solüsyonu)**

Formalin, sulu formaldehit çözeltisi olup, su ürünlerinde yetiştiriciliğinde en çok kullanılan dezenfektanların başında gelmektedir (Leal vd., 2018). Formol etki mekanizması proteinler, DNA ve RNA, polisakkaritler ve glikoproteinler gibi çeşitli biyolojik makromoleküllerin fonksiyonel gruplarıyla reaksiyona girmektedir (Kiernan, 2000). Balık parazitlerinde ve mantar hastalıklarında kullanılmakta olup çoğu parazit gruplarında etkili olmaktadır. Balıkların solungaçları, derisi, yüzgeçlerinde ve yumurtalarındaki parazitleri öldürmek için kullanılabilir fakat iç organları enfekte etmiş parazitleri tedavi etmek için kullanılmamaktadır (Francis-Floyd, 1996). Uygun doz ve uygun tedavi süresinin dışına çıkılmasında balıklar üzerinde doku hasarına neden olmaktadır. Çalışmalarda en yaygın olumsuz sonuçlar; solungaçlarda kalıcı hasar (Shepherd & Bromage, 1988), hipokloremi, kan hemoglobini ve plazma konsantrasyonunda artış (Leal vd., 2018) görülmüştür. Bu bulgular önerilen tedavi süresinden daha yüksek tedavi süresinin uygulanması sonucu ortaya çıkmıştır.

### **Metilen Mavisi**

Metilen mavisi, trisiklik bir fenotiyazin bir boyadır (Wainwright ve Amaral, 2005). Su ürünleri yetiştiriciliğinde dezenfektan ve bazı hastalıkların tedavisinde kullanılmaktadır. Son yıllarda yapılan çalışmalarda metilen mavisinin teratojenik etkilerinin olduğu rapor edilmiştir (Lv vd., 2018). Metilen mavisi bakteri ve parazitlerin sitoplazmik yapılarına bağlanarak oksidasyon redüksiyon reaksiyonları bozarak etki göstermektedir (Bolivar vd., 2001). Bu mekanizma şöyle olmaktadır; ışıkla aydınlatıldıktan sonra fenotiyazin yapısı uyarılıp sonra dioksijen ile reaksiyona girerek singlet oksijen, hidrojen peroksit, süperoksit anyonu ve hidroksil radikalleri gibi bir reaktif oksijen türleri (ROS) kompleksi üretir. Bu ROSlar, proteinler, nükleik asitler ve lipitler gibi biyolojik molekülleri oksitleyerek hücre hasarına ve ölüme neden olmaktadır (Almeida vd., 2020). Metilen mavisi nitrat zehirlenmesi, amonyak zehirlenmesi, *Ichthyophthirius multifiliis* (Beyaz benek hastalığı), akvaryum balıklarında kadife hastalığı, yüzme kesesi hastalığı, balık yumurtalarındaki mantarlarda ve stres altındaki balıklar kullanılması gibi birçok kullanım alanı mevcuttur.

### **Bakır Sülfat**

Kültür ortamındaki mavi-yeşil alglerin kontrolü, belirli hastalıkların kontrolü, yumuşakçaların havuzlardan uzaklaştırılması ve balık ağ kafeslerinin kirlenmesini önlemek için su ürünleri yetiştiriciliğinde çeşitli amaçlarda kullanılmaktadır. Kullanım dozu genellikle 1/2000 oranındaki solüsyon balıklara 1-2 dk banyo şeklinde uygulanmaktadır. Kullanırken personellerin dikkat etmesi son derece önemlidir. Maruz kalma sonrasında burun, ağız ve göz tahrişlerinin yanı sıra baş ağrısına neden olmaktadır.

### **Malaşit Yeşili**

Malaşit yeşili, ilk olarak tekstil endüstrisinde kullanılan 1930'ların başından beri kültür balıkçılığında yaygın olarak kullanılan diammin trifenil metilen boyadır (Rushing ve Thompson, 1997). Balık yumurtalarında, larvalarda, yetişkin balıklarda ektoparazitleri ve mantar gelişimini inhibe etme yeteneğine sahiptir (Wu vd., 2007). Balık dokularında kalıntı bırakması doğrudan tüketime sunulan balıklar için sorun olmakta ve ihracat engeline yol açmaktadır (Hashimoto vd., 2011).

### **Potasyum Permanganat**

Potasyum permanganat (KMnO<sub>4</sub>), su ürünleri yetiştiriciliğinde uzun yıllardır kullanılan oksitleyici bir maddedir. Balık havuzlarında solungaçlarda ki parazitleri, bakteri ve mantar enfeksiyonlarını tedavi etmek amacıyla kullanılmaktadır (Lazur, 1996). Potasyum permanganat kuluçkahanede 10 mg/L 30-60 dakika ve 500 mg/L 30 saniye yüzey dezenfektanı olarak kullanılabilir (Francis-Floyd ve Klinger, 1997). Avantajların yanında dezavantajları da bulunmakta organik maddeleri etkilemesi, alkali ve asit sularda manganez reaksiyonuna yol açabilmektedir.

### **Tuz**

Paraziter hastalıklar balıklara bulaştıklarında mukus sekresyonunda artış meydana gelmektedir. Mukus artması parazitlerin ve parazit kistlerinin üzerini kapatabilir bu da kullanılan kimyasalın etki etmesini engellemektedir. Fazla mukus artması bir diğer etkisi solungaçlar filamentlerinin şişmesine neden olur. Tuz uygulaması balıkların vücudundaki ve solungaçlarındaki fazla mukusun atılmasına yardımcı olmaktadır. Tuz uygulaması banyo şeklinde yapılmakta olup, %3 yoğunluğunda hazırlanmaktadır.

### **Sönmemiş Kireç**

Sönmemiş kireç birçok alanda sıklıkla ve su ürünlerinde kullanılan dezenfektanlardan biridir (Bondad-Reantaso vd., 2012). Sudaki kireç miktarı asitleri bağlama kapasitesiyle ölçülmektedir. Su ürünlerinde kullanımı havuzların temizlenmesi ve bakterilerin yok edilmesi amacıyla kullanılmaktadır (Bondad-Reantaso vd., 2012).

## SONUÇ

Dünyada ve ülkemizde su ürünleri yetiştiriciliği sürekli artmaktadır. Ülkemizde tüketici bilincinin artmasıyla ilerleyen zamanlar su ürünleri tüketimi artacağı tahmin edilmektedir (Öz & Üstüner, 2021). Bundan dolayı balıkların tüketiciye hastalıklardan arı ulaştırılması son derece önemli olmaktadır. Hastalıkların kontrol altına alınmasında ve hastalıkların önlenmesinde kullanılacak dezenfektanların bilinmesi bundan dolayı son derece önemli olmaktadır. Su ürünleri yetiştiriciliğinde kullanılan antiseptik ajanların, balık sağlığı üzerinde maksimum faydayı sağlaması ve çevre üzerindeki minimum düzeyde etki bırakması kabul edilebilirliği açısından çok önemlidir. Balık çiftliklerinde standart bir dezenfeksiyonu sağlamak için belli kriterler bulunmaktadır bunlar; Geniş bakteriyostatik ve bakterisit etkileri olan dezenfektan seçilmeli, hazırlanan dezenfektan günlük hazırlanmalı ve dezenfekte edilecek yüzeyler önceden sıcaklık işleminden geçirilmeli, kullanılan dezenfektanların uzun süre kullanılması veya yoğun dozlarda hazırlanma korozyona neden olabileceği, dezenfektanı kullanacak personelin kendini koruyucu önlemler alması, dezenfektanın balıkların derisinde ve kendisinde toksit bir etki bırakmaması gerekmektedir.

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# INVESTIGATION OF THE EFFECT OF DILL LEAF ENRICHMENT ON THE CHEMICAL QUALITY OF TUNA PATE DURING REFRIGERATED STORAGE

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## **ABSTRACT**

The variety of spreadable food products is increasing due to changing consumer preferences and developments in the food sector. The transformation of seafood into new products with different processing methods is part of the sustainable economy and processed seafood accounts for the majority of our exports. Tuna fish has a huge percentage of processed aquaculture products and is generally processed by canning method and finds a place in both the domestic market and the foreign market. The evaluation of the by-products formed as crumbs during the canning of tuna has been an economic approach to bring these nutritionally very rich products to the food industry. In addition to the rich nutrients it contains, fish require maximum attention to processing and storage conditions due to their vulnerability to deterioration and need alternative solutions. Natural plants are used both by the use of their extracts and by their direct participation in food formulation. In this study, the effects of dill, which is known to have antioxidant properties, on the chemical quality of the product during the storage of spreadable pate products obtained from tuna processing by-products in the refrigerator were investigated.

The group without the dill was considered a control group and stored under the same conditions as the group containing the dill. Storage was made in transparent glass jars, amber jars and plastic packaging to determine the oxidation more clearly. During the 6-month storage in the refrigerator, oxidation values such as TBA, peroxide and free fatty acids as well as TVB-N changes were analyzed. The results of the research showed that the addition of dill delayed the oxidation of tuna skating in particular and caused statistically different results with the control group. The addition of dill suggests that it indirectly provides longer shelf life in tuna pates.

**Keywords:** Seafood, quality, oxidation, refrigerated storage, dill leaves, tuna, spreadable pate

## **INTRODUCTION**

While the traditional pate prepared with goose liver which is known as "foie-grass", the increasing demand to this product and the price had to tend to producer usage to alternative sources. From pork livers and chicken livers to different animals offal have been used for pate production (Estévez et al., 2007; Polak et al., 2011). The market size of pate was more than a billion USD in 2018, and it is estimated to increase total size by 1.3 % between 2019 and 2025 (Grand View Research, 2019). Recently fish species have used in pate production due to their functional characteristics and health benefits. Higher bioavailability rate and containing 20% more protein than meat pate make fish pate a popular seafood product (Branciari et al., 2019). Especially, fatty fish species are used for pate production owing to their desirable organoleptic and textural properties (Aksun Tümerkan et al., 2021).

Different processing techniques, using of natural antioxidants, packaging materials are robust approaches to avoiding chemical quality deterioration. Utilization of various plant leads to chemical quality stabilization whilst delaying to oxidation in addition to improvement of the overall quality of food products. Thus, this research aimed to investigate the impact of dill leaf as an antioxidant compound on the chemical quality of refrigerated tuna pate packed in various materials.

## **MATERIALS AND METHODS**

### **Materials**

Tuna (*Katsuwonus pelamis*) by-products (chunks and trimmings obtained after canned tuna processing) in pre-cooked form used as raw material for tuna pate production. The chunks and trimmings were obtained from seafood processing plant (Sasu Ltd., Adana, Turkey) the other ingredients (milk powder, spices, starch,

and lemon juice) were acquired from local market in Adana, Turkey in fresh form. Tuna chunks were transported to the laboratory immediately and stored at -80°C up to following process. Dill leaves (*Anethum graveolens*) were also acquired from the local market freshly and then cleaned, dried and grinded.

### **Tuna pate preparation and storage**

Tuna chunks and other compounds were mixed in two different formulations for the production of the tuna pate groups. Frozen tuna trimmings and tuna chunks were thawed and chopped then mixed with mush potato, milk powder, salt, starch, and sunflower oil, spices and other ingredients in a dough mixer at 4°C until obtaining a well homogeniated tuna trimmings dough. Mixed pate dough was separated into 2 groups: Control group (C) signed as without any other ingredient and dill leaf enriched (DE) group prepared with lemon juice and dried dill leaves addition to control groups while mixing gradually. Then, each pate group was separated into three packaging material (F: flint glass jar, A: amber glass jar and P: plastic container). Control and dill leaf enriched tuna pate groups in different packaging materials labeled as CF, CA, CP, DEF, DEA, DEP. The control and dill leaves enriched pate sample were manually full filled into the glass jars and plastic container (~100 g). Then, the packaged tuna pate pasteurized at 80 °C for 45 min laboratory-type oven with slight modification the method described by Estévez, and Cava, (2004). All tuna pate groups were stored at 2±1 °C during 6 months. For each groups, chemical analyses were carried out in triplicates on the planned weeks

### **Chemical Quality Assessment of Tuna Pate during storage**

#### **Determination of pH**

The pH values of tuna pates were recorded by a digital pH meter (WTW- 315i pH Meter, Weilheim, Germany) after homogenization of each 5 g of pate sample in 50 mL of distilled water (Santos et al., 2003).

#### **TVB-N and TBA analysis**

Total volatile base nitrogen (TVB-N) content was determined by the method of Antonocopoulos (1973) homogenized pate samples were steam-distilled and the TVB-N value were expressed as mg of TVB-N per 100 g of pate sample and measured depends on used 0.1 M HCl volume for titration. The value of thiobarbituric acid (TBA) was determined according to the method mentioned by (Tarladgis et al., 1960). The extraction of fat breakdown compounds from 10 g of homogenized pate samples with a mixture of 2.5 ml 6 N HCl and 97.5 ml of distilled water using steam distillation unit (Distillation Unit B-324, BÜCHI, Labortechnik). Then distillate and glacial acetic acid (90%) were mixed (1:1, v/v) and heat treatment (80-85 °C) was applied. TBA reacted complex was measured at 538-nm in a UV/Visible spectrophotometer (Perkin Elmer Lambda 25, Massachusetts, USA) and the data expressed as milligrams of malondialdehyde (MA) per kg of tuna pate.

#### **Determination of Free fatty acid and Peroxide value**

Peroxide value (PV) of tuna pates expressed as meq of peroxide oxygen per kg fat and accomplished by using the AOCS method Ja 8-87 (AOCS, 1994) which is based on the amount of iodine used for the reaction of peroxides with the iodide ion. Free fatty acid analysis (FFA), performed according to the AOCS method Ca 5a-40 (AOCS, 1997) which is based on alkaline titration and the results were expressed as oleic acid equivalents.

#### **Statistical analyses**

Statistical analyses were performed in software SPSS version 19 (Chicago, Illinois, USA). Statistical analysis of chemical quality and sensory attributes included descriptive statistics (means and standard deviations) in triplicate in a general linear model was used to determine the statistically significant differences  $p < 0.05$

## **RESULTS AND DISCUSSION**

### **Chemical quality of tuna pate during storage**

The influence of dill leaf usage and packaging in the different material on chemical parameters of tuna pate through refrigerated storage were showed in Table 1. Statistical analysis revealed that pH values were considerably affected by the usage of dill leaf and packaging material and storage time. Initial pH values were found 6.36 and 6.30 for C and DE group respectively. These results are in accordance with those of previous findings (Nakamura et al., 2007) who determined the pH decreases of Pacific Bluefin tuna (*Thunnus orientalis*) as 6.30-6.40. The pH values have fluctuated after 7 weeks of storage, the differences between groups became statistically significant ( $p < 0.05$ ) reached the lowest value at the end of storage. The decline of pH values could be related to pH changes of tuna chunk and other additives such as milk powder, mush potato and dill leaves. Declined pH values during storage can be connected that pH values of pate



type emulsified meat product affected by soluble protein rate, emulsion viscosity and production temperature (Zhou et al., 2021).

The results of TVBN values, as the most useful indices for spoilage in fish products were shown in Table 1, from which it could be noticed that initial TVBN value as 11,61 mg/100g for control and 13,74 mg/100g for DE group. Similar TVBN values were found as 13.4-16,3 mg/100g for tuna species carried out by other researcher (Silbande et al., 2016). Through the refrigerated storage, TVBN values of all tuna groups increased progressively reached its maximum values at the end of storage, week 24th. In terms of treating with dill leaves, generally, lower TVBN rates determined in DE as compared to C samples. These results are in agreement with a previous research (Balıkçı, 2009) who stated that dill leaf addition lead to reduction of TVBN formation in fish product during refrigerated storage ( $4\pm 1^{\circ}\text{C}$ ). Regardless of with or without dill leaves enrichment, storing in glass jar particularly in the amber glass jar and the plastic container had the lowest and highest TVBN values, respectively at all analysis period. The plastic material packaging can cause these important variations has been more permeable than glass material packaging for food products (Dhanesh et al., 2018).

**Table 1.** Chemical quality evolution of tuna pate groups during storage

Parameters	Storage time (weeks)							Groups
	0	7	12	16	20	22	24	
pH	6,36±0,0 7a5	7,10±0,06 b23	7,09±0,04 <sup>a</sup> 23	7,24±0,05 <sup>a</sup> 2	6,27±0,0 7d56	6,22±0,16 a6	5,94±0,05 ab6	CF
	6,36±0,0 7a5	7,15±0,10 b12	6,91±0,05 <sup>b</sup> c23	7,25±0,06 <sup>a</sup> 1	6,88±0,0 9b23	6,14±0,04 a4	5,76±0,55 b5	CA
	6,36±0,0 7a5	7,18±0,05 b12	6,93±0,05 <sup>b</sup> c34	7,32±0,35 <sup>a</sup> 1	6,84±0,1 9b45	6,17±0,08 a7	6,11±0,07 ab7	CP
	6,30±0,0 6a6	7,08±0,03 b23	6,96±0,03 <sup>b</sup> 4	7,15±0,10 <sup>a</sup> 2	6,60±0,0 3c5	6,07±0,05 a8	6,23±0,16 a7	DEF
	6,30±0,0 6a6	7,43±0,33 a1	6,84±0,04 <sup>c</sup> 34	7,27±0,06 <sup>a</sup> 12	6,66±0,0 3c4	6,28±0,11 a5	5,83±0,36 ab6	DEA
	6,30±0,0 6a6	7,03±0,09 b2	6,74±0,14 <sup>d</sup> 3	7,26±0,09 <sup>a</sup> 1	7,02±0,0 5a2	6,24±0,28 a4	5,93±0,05 ab5	DEP
TVB-N (mg/100g)	11,61±1, 46a6	14,91±0,4 1b56	18,39±0,3 7b456	23,29±0,3 9ab34	41,00±0, 43a2	43,92±0,5 7b2	59,31±3,1 4ab1	CF
	11,61±1, 46a6	14,21±0,4 1b6	17,01±0,3 9bc56	21,88±1,0 7bc45	35,87±2, 02b3	42,05±2,2 3bc2	56,34±0,9 4b1	CA
	11,61±1, 46a6	17,43±0,7 4a5	20,21±0,6 9a45	24,37±0,7 0a34	40,71±1, 09a2	54,15±1,0 6a1	61,99±0,6 7a1	CP
	13,75±1, 76a8	15,13±1,0 4b78	20,23±0,7 0a6	21,62±0,7 1c5	31,18±0, 82c3	41,47±1,1 7c2	53,13±1,4 2c1	DEF
	13,75±1, 76a8	15,34±0,7 0b6	16,46±1,4 5c56	22,56±1,1 1bc4	32,77±2, 04c3	41,40±0,7 4c2	51,20±1,6 9c1	DEA
	13,75±1, 76a8	17,23±0,7 8a56	16,68±0,7 0c6	19,98±0,8 1d5	43,77±0, 83b2	43,77±0,8 3b2	56,33±0,4 9b1	DEP
TBA (mg MA/kg )	0.55±0,0 5a6	0.54±0,05 a6	1.98±0,12 <sup>b</sup> 456	2.08±0,06 <sup>a</sup> b34	3.87±0,1 1a2	6.57±0,11 b2	6.38±0,12 ab1	CF
	0.55±0,0 5a6	0.36±0,05 a6	0.94±0,04 <sup>b</sup> c56	1.49±0,11 <sup>b</sup> c45	2.57±0,0 7b3	4.37±0,13 bc2	5.99±0,17 b1	CA
	0.55±0,0 5a6	0.56±0,05 a6	2.04±0,10 <sup>a</sup> 45	2.25±0,15 <sup>a</sup> 34	3.95±0,0 13a2	6.88±0,06 a1	6.52±0,21 a1	CP
	0.45±0.3 <sup>a</sup> 7	0.48±0.3 <sup>a6</sup>	1,54±0,08 <sup>a</sup> 6	2,03±0,09 <sup>c</sup> 5	3.55±0,2 7c3	5.12±0,04 c2	6.00±0,20 c1	DEF
	0.45±0.3 <sup>a</sup> 7	0.27±0.3 <sup>a8</sup>	0,86±0,14 <sup>c</sup> 56	1.38±0,04 <sup>b</sup> c4	2,39±0.1 7c3	4,21±0,03 c2	5,28±0,14 c1	DEA
	0.45±0.3 <sup>a</sup> 7	0.55±0.3 <sup>a8</sup>	1.80±0,22 <sup>c</sup> 6	2,07±0,03 <sup>d</sup> 5	3,78±0,1 1b2	5,81±0,15 b2	6,29±0,13 b1	DEP

PV (meq/kg)	0,91±0,1 1a6	3,93±0,28 ab5	9,86±0,66 <sup>a</sup> 4	9,85±1,09 <sup>b</sup> 4	15,57±1, 52a3	19,28±2,3 3a2	24,98±1,4 7a1	<b>CF</b>
	0,91±0,1 1a6	3,65±1,12 ab3	6,94±0,52 <sup>b</sup> c23	9,42±0,93 <sup>b</sup> 2	16,53±1, 97a1	17,03±4,6 0ab1	15,63±0,9 7c1	<b>CA</b>
	0,91±0,1 1a6	4,65±0,57 a4	10,56±0,9 5a3	12,33±0,7 7a2	14,72±0, 61a2	21,07±2,0 6a1	22,11±2,0 0b1	<b>CP</b>
	1,17±0,0 4b5	3,29±0,48 b4	8,95±0,61 <sup>a</sup> b3	9,34±0,96 <sup>b</sup> 3	11,91±0, 94b2	13,40±1,1 9bc2	15,05±1,7 5cd1	<b>DEF</b>
	1,17±0,0 4b5	3,08±0,28 b5	5,45±0,10 <sup>c</sup> 4	9,09±0,49 <sup>b</sup> 3	9,09±0,9 6c23	10,58±1,4 7c2	13,07±0,5 7d1	<b>DEA</b>
	1,17±0,0 4b6	3,86±0,80 ab5	4,34±3,42 <sup>c</sup> 5	10,36±0,6 2c3	9,15±1,0 2c4	13,27±2,2 1d2	18,33±0,0 6e1	<b>DEP</b>
FFA (% oleic acid)	0,92±0,3 9a5	1,74±0,46 a5	2,03±0,37 <sup>a</sup> b45	3,46±0,76 <sup>a</sup> bc34	10,22±1, 11a2	14,93±1,7 gab1	16,07±0,7 6ab1	<b>CF</b>
	0,92±0,3 9a5	1,42±0,33 a34	1,42±0,65 <sup>b</sup> 34	2,51±0,40 <sup>c</sup> d34	8,89±0,9 0a2	13,50±1,9 gab1	14,60±1,4 3ab1	<b>CA</b>
	0,92±0,3 9a5	1,71±0,84 a7	3,18±0,30 <sup>a</sup> 567	4,55±0,63 <sup>a</sup> 5	11,37±1, 45a3	14,94±1,0 6ab2	17,56±2,3 1a1	<b>CP</b>
	0,82±0,1 1a5	1,48±0,56 a45	1,83±0,66 <sup>a</sup> b45	3,25±0,49 <sup>b</sup> cd34	9,42±0,7 1a2	13,99±2,2 gab1	14,99±2,8 6ab1	<b>DEF</b>
	0,82±0,1 1a4	0,96±0,47 a4	1,55±0,88 <sup>b</sup> 4	2,19±0,64 <sup>d</sup> 34	8,67±2,9 0a2	12,79±0,6 6b1	13,46±2,0 2b1	<b>DEA</b>
	0,82±0,1 1a7	1,70±0,50 a67	2,05±1,33 <sup>a</sup> b67	3,89±0,60 <sup>a</sup> b45	10,90±0, 94a3	16,78±0,4 2a1	14,90±0,7 4a <sup>b</sup> 2	<b>DEP</b>

Data are expressed as mean value ± standard deviation of 3 replicates in duplicate; Means sharing the same letter in the same row (a-e) indicate significant differences ( $p < 0.05$ ) among groups.

TVBN values reached the maximum values at week 22 between 41.40 and 54.15 mg/100g, which are exceed limits of 35–40 mg TVB-N/100g of fish flesh (Connell, 1995).

The TBA value widely acts as a sign of oxidative degradation of the fish product (Crexi et al., 2010). As shown in Table 1, TBARS values of tuna samples were affected statistically significantly ( $P < 0.05$ ) by plant enrichment and storing in the different packaging material. The initial TBARS values were determined to be 0,55 mg MDA/kg for C and 0.45 MDA/kg for DE group. Packaged in the glass jar, especially the DEA group, relatively delayed the TBA increase. With or without dill leaf enrichment, storing in the plastic container has the highest TBA values among the groups. While CP and DEP groups were rejected at week 20, all glass jar groups rejected at week 22. Enriched with dill leave prolonged to reach the rejection limit TBA values of tuna pates. Dill leaves acted as a natural antioxidant and inhibitor for the breakdown of the MDA caused by tertiary deterioration. Higher TBARS values were observed of all tuna pate groups as the storage time increased ( $P < 0.05$ ). At the end of storage time, the lowest and highest TBARS values were found in DEF and CP group with 5.28 and 6.52 MDA/kg, respectively. These results support the previous research that usage of different natural antioxidant prolonged the lipid oxidation and TBARS forming during refrigerated storage for 6 months (Pateiro et al., 2014).

Peroxide value (PV) considered as indices of hydroperoxides, that resulted from primary oxidations and use for determination of rancidity in fish products (Tiwari et al., 2009). At the initial period of storage, PV values found as 0.91 and 1.17 meq O<sub>2</sub>/kg for C and DE groups, respectively. Peroxide analysis results revealed that peroxide formation was increased gradually and important variations were observed among groups during refrigerated storage (P<0.05) (Table 1). Regardless of packaging material effect, DE groups had lower PV values than C groups, can be related to the antioxidant effect of dill leaves on tuna pate. While all DE groups determined below the upper limit for human health, which is 20 meq/ kg during storage, some of control pate groups exceed this limit over 22 weeks of storage. These findings support the previous statement as using of plant or plant extract can inhibit the peroxide formation in fish products (Özogul et al., 2017).

As a tertiary result of rancidity, free fatty acid (FFA) result revealed that FFA content was influenced by dill leaf enrichment and storing in whether glass or plastic material. At the earliest stage of storage, FFA values of tuna pate were measured found 0.92 and 0.82 (% oleic acid) for C and DE groups, respectively. Dill leaf enrichment led to statically significant decreases in FFA values within storage period that can be dill leaf inhibition correlated enzymatic activity and microbial growth which are responding to FFA formation. Likewise, (Özogul et al., 2017) highlighted that using plant or plant extracts delayed the lipid oxidation effectively in fish products during refrigerated storage. Regardless of with or without DE enrichment, CA and DEA groups (stored in the amber glass jar) had lower FFA values than other groups. These significant differences can be explained by FFA formation is accelerated by light and the amber glass could be delayed this acceleration (Adeyeye et al., 2016). At the final day, only CF and CP groups reached the maximum values 16.07 and 17 .56 % oleic acids which is above the rejection limits of 15 mg/g (as oleic acid) (Ozogul, and Balikci,2013).

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# QUALITY FACTOR MECHANISMS IN SMOKED FISH

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## ABSTRACT

Smoking is one of the most traditional methods known and increases the product variety by adding different aroma and taste to the product to which it is applied. It is applied to many food products, from meat products to cheese, from seafood to beverages such as beer. Smoked seafood is one of the leading foods that most exported products. Although the smoking process has been applied mostly as hot smoking in the past, different processing methods such as cold smoking and liquid smoking have also started to be used due to changing consumer preferences and technological developments. The nutritional composition, muscle pH, textural characteristics and sensory characteristics of fish are known as the main factor in choosing the method of processing. It is known as the most important factor, mainly because the lipid content of fish causes oxidation during the processing and storage of the product, the sensory acceptability of the product with bitterness, and limits the storage period of the product. However, the denaturation mechanism of fish muscle, which is known for its high protein content, due to heat processing and protein oxidation, which is rarely seen, affect the shelf life and sensory characteristics, especially the bioavailability, of processed fish. In this review, the mechanisms of factors on quality in smoked fish, which have an important place in the processed seafood market, will be evaluated in detail. The factors discussed in this review will benefit a wide range of people from the industry companies engaged in the smoking process to the packaging industry as well as the scientists working on the area.

**Keywords:** Smoking, seafood, nutrient composition, processing method, quality control

## INTRODUCTION

Smoking process extend storage period of food products than to this method combined effect heat treatment, drying and salting. As very known salt inhibited microbial growth within reducing water activity. Drying with high-temperature offers a protective effect on the fish and with smoking step limit the bioaccumulation of different components (Leroi and Joffraud, 2000). Within changing consumer demand, the main aim of smoking process is its effects on the organoleptic characteristics of the fish products instead of its protective impacts (Arason et al.,2014; Puke and Galoburda,2020). There are several smoking process that used in the seafood processing commonly; as in form hot,cold,liquid and/or combine of them smoking. The factors impact on the quality mechanism of smoked fish products

### Raw material

The physico-chemical properties of fish muscle greatly play role in the quality parameters of smoked fish products (Boziaris et al.,2013). Factors such as the area where the fish is fished, the fishing method or the fact that the raw material is fish or farmed fish caught from nature are among the factors resulted the variance of the quality of raw materials. The lipid content and distribution of lipids have a significant impact on the quality and nutritional value of the final products such as texture, taste and flavor (Wu et al.,2020). Lower lipid in the fish muscle leads to the relatively higher level of phenol in the smoked fish species which sign as lipid rate directly impact on the quality of end smoked fish (Arason et al.,2014; Asamoah et al.,2022).

**Types of Wood**The source of producing smoke is the tree. Not all types of wood are suitable for smoking, and this depends on the tree species, since the smell and taste of wood differs. In the process of smoking, tree species such as beech, hornbeam, oak, linden, apple and orange are preferred. Pine and other coniferous resinous trees are not preferred because they add a bitter taste to the product (Boziaris.,2013).

### Salting Process

Salting accepted as the main phases in the smoking process. Salt prolongs the storage period of the product by acting as a protector in the fish muscle, reducing water binding capacity and inhibition of bacteria and also provides the desired rheological properties in the smoked fish (Arason et al.,2014). In the smoked fish industry, several salting techniques are commonly applied alone or combined such as dry salting, injection salting and brine salting (Espe et al., 2002). In dry salting, salt is applied directly to fish, while in brine salting, fish is preserved in salt solution.(Rørvik et al.,1997). Since the water loss in fish meat is less in wet salting compared to dry salting, meat yield is also higher and wet salting is widely preferred in industry

(Slámová et al.,2021).Salting time and salt concentration vary according to factors such as the type of fish, the fat rate, the smoking methods and the storage period (Walker,2011).The salt ratios, temperature and salting durations used do not have a certain standard as in the same dry salting technique (Wu et al.,2020).

### **Drying Method**

Drying approach provides a protective impact within reducing water activity in smoked fish products. The drying period and techniques used in the fish products differ according to the type of fish and consumer demand (Arason et al.,2014). Drying can cause negative effects on process yield such as product quality, texture and color of fish products. In smoked fish products, the microbial flora can also change depending on the drying conditions.

### **The accumulation of PAHs in the smoked products as a risk**

PAHs are organic compounds resulted from incomplete combustion of of natural or human origin and generally caused by forest fires or volcanic eruptions or human-related resources,such as motor vehicles and cigarettes (Stadler and Lineback,2009). Although the amount of PAH produced by smoking is less than the others, it is among the sources that pose the most threat to human health. There are various studies aimed at illuminating the ways in which oil and hydrocarbons in marine, and freshwater ecosystems are biodegraded (Slámová et al.,2021). Due to smoking process accelerating the formation of PAHs, the quality mechanism is also impacted by the previously mentioned factors.

### **CONCLUSION**

This review deeply considered the factors affecting the quality attributes of smoked fish products. This evaluation could be useful for both academia and relevant industry. PAHs formation mechanism also investigated which will be guide for the other smoked products.

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## II. INTERNATIONAL HYGIENE CONFERENCE

REF : Akademik Teşvik

07/09/2022

### İLGİLİ MAKAMA

2. Uluslararası Hijyen Kongresi 24 Ağustos 2022 tarihinde çevrimiçi 7 farklı ülkenin (Türkiye-5, Diğer Ülkelerden-8) akademisyen/araştırmacılarının katılımıyla gerçekleşmiştir. Kongre 16 Ocak 2020 Akademik Teşvik Ödeneği Yönetmeliğine getirilen "Tebliğlerin sunulduğu yurt içinde veya yurt dışındaki etkinliğin uluslararası olarak nitelendirilebilmesi için Türkiye dışında en az beş farklı ülkeden sözlü tebliğ sunan konuşmacının katılım sağlaması ve tebliğlerin yarısından fazlasının Türkiye dışından katılımcılar tarafından sunulması esastır." değişikliğine uygun düzenlenmiştir.

Bilgilerinize arz edilir,  
Saygılarımla



**Assoc. Prof. Dr. Seyithan SEYDOŞOĞLU**  
Head of the Symposium