



# Pulsed electric field processing of pistachio nuts with preservation of quality properties and surface disinfection

7th FOOD SAFETY  
CONGRESS

**Serife Mustuloglu, Irem Demir, Gulsun Akdemir Evrendilek**

**Faculty of Engineering, Department of Food Engineering, Bolu Abant İzzet Baysal University,  
Golkoy Campus Bolu, Turkey**



# Background

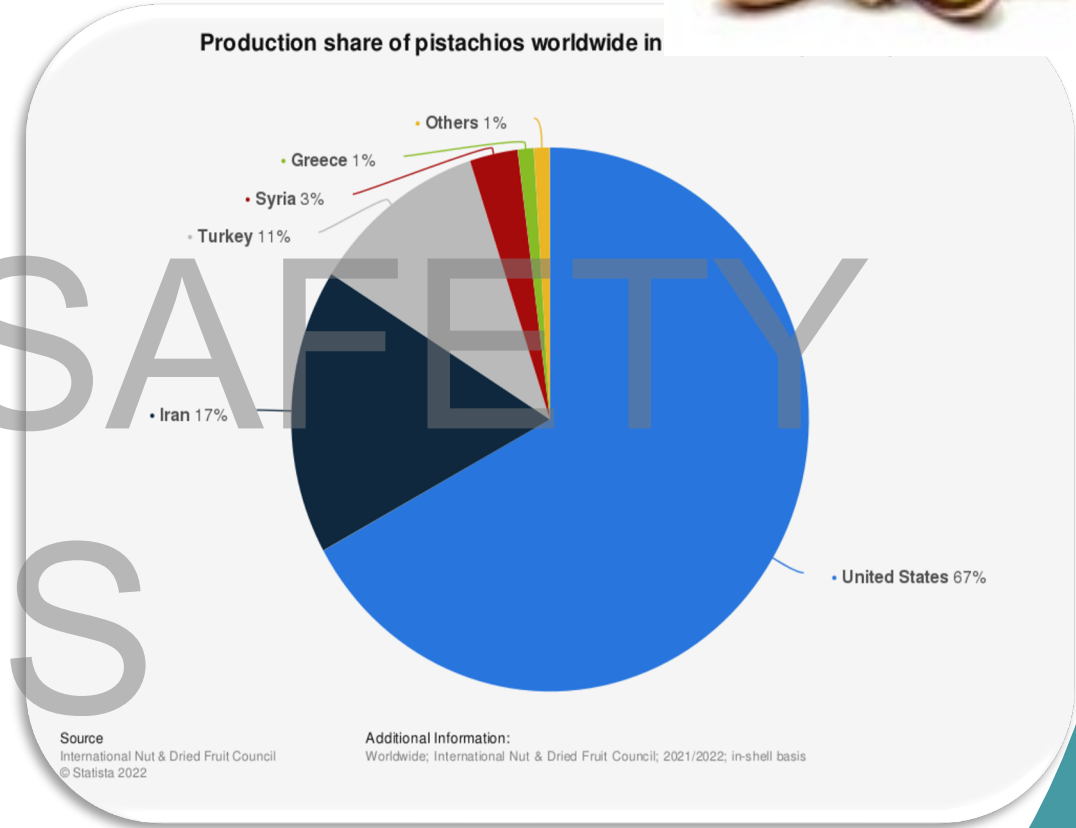
- **Pistachio** (*Pistacia vera*) fruit, a member of the cashew family
- A small tree originating from Central Asia and the Middle East
- The fruit seeds widely consumed as food.



# Background



## Pistachio Nuts Production



Source: International Nut & Dried Fruit Council © Statista 2022

Additional Information: Worldwide; International Nut & Dried Fruit Council; 2021/2022; in-shell basis



Pistachio is very important agricultural product with high economical value not only in Turkey but also all over the World



# Problem



**Contamination**



**Contamination**

7th FOOD SAFETY CONGRESS

- Contamination with soilborne as well as food borne pathogen bacteria in addition to fungi including aflatoxin producing *Aspergillus* spp
- Lowered product quality resulting with economic loss
- Required surface disinfection with no adverse changes in physical, quality and sensory properties

# Objectives

1

**Design and construct a PEF processing unit to treat particles, flakes, low-moisture foods**

2

**PEF treatment of pistachio nuts with no and/or minimal changes in quality properties**

3

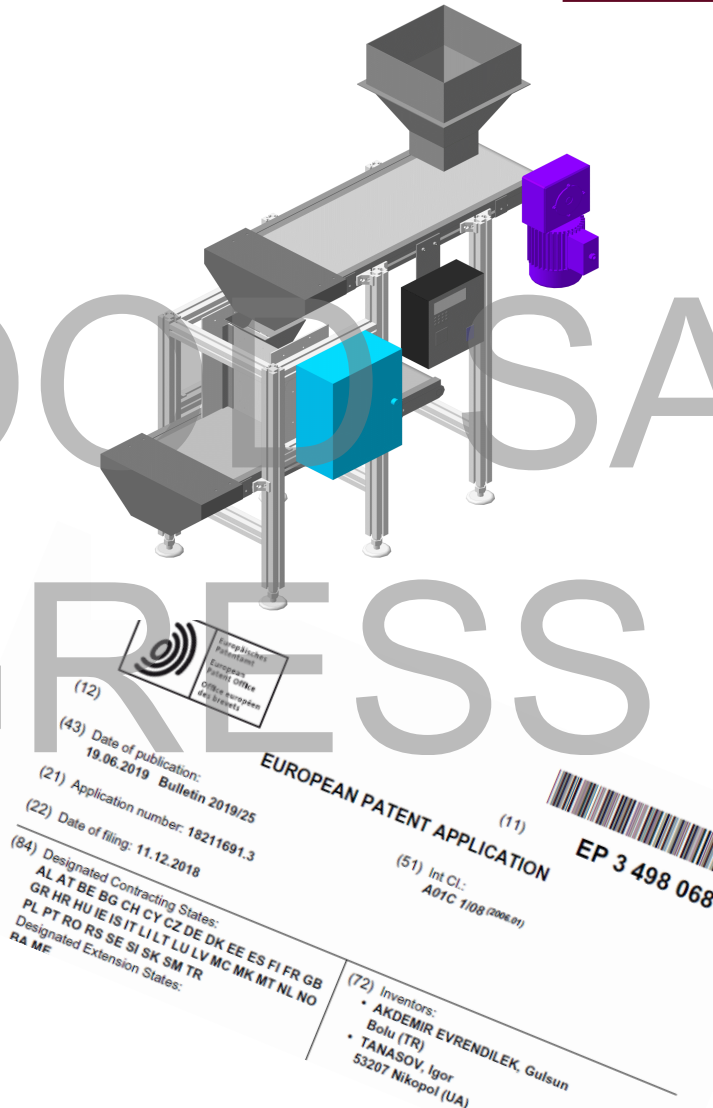
**Inactivation of surface microflora**



# Pulsed electric field processing of pistachio nuts

## Advantages

- PEF being physical application does not leave any residue
- Destructive effect of applied electric field on chemical compounds
- No need to use chemicals
- Limited number of studies for particulate foods such as pistachio



## Hurdles

- To form uniform electric field strength without any transmitting fluid
- Processing of particulated foods
- Microbial inactivation
- No significant/adverse effect on quality properties

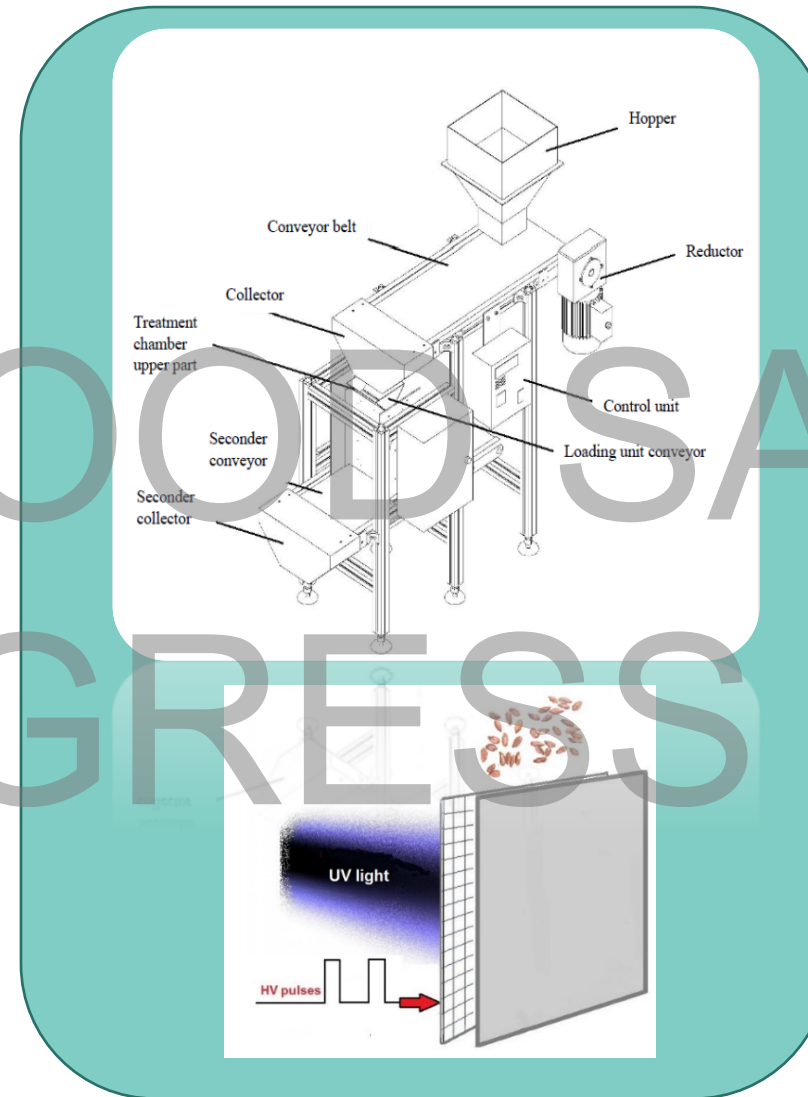
# Pulsed electric field processing unit

-Ionization of air by UV lamp

-Max 20 kV electric field and 300 Hz frequency

-Treatment time is equal to passing the samples through electrodes

-Treatment of the nuts by 2.97 to 71.23 J J energies (100-300 Hz frequencies)



-Treatment of particulate food grains and seeds

-Vertical parallel plate treatment chamber with various size

-Adjustable distance between two plates

-Monopolar square wave pulse



# Material and Method

## Pistachio samples

Dried nuts without shell provided by Adagro Gıda (Gaziantep, Turkey)

### Quality parameters

- Color measurement
- Peroxide value
- Acid value
- Total antioxidant capacity
- Total phenolic substance content
- Total chlorophyll content

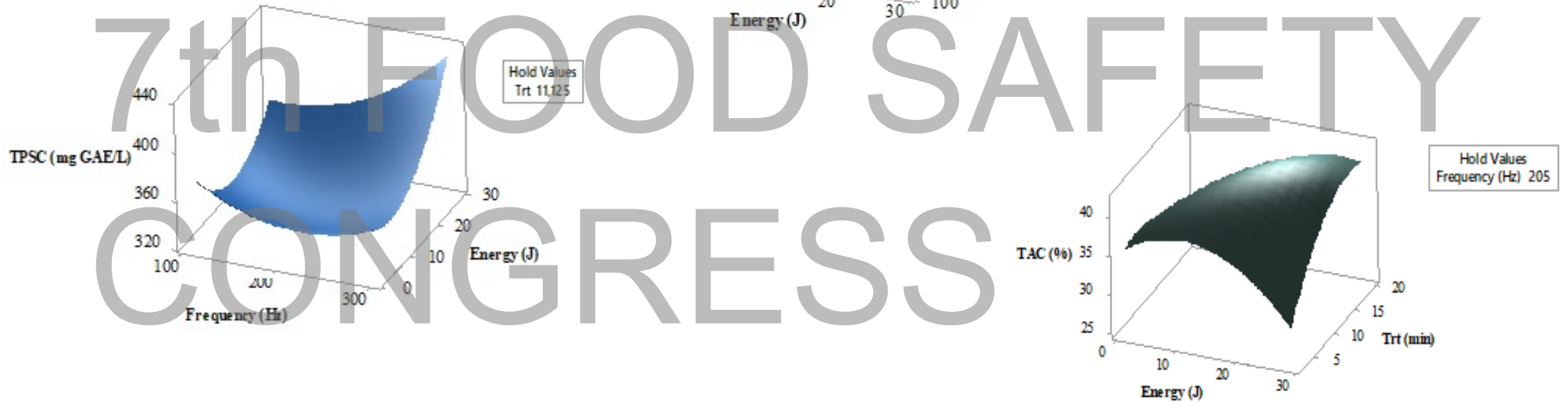


### Safety parameters

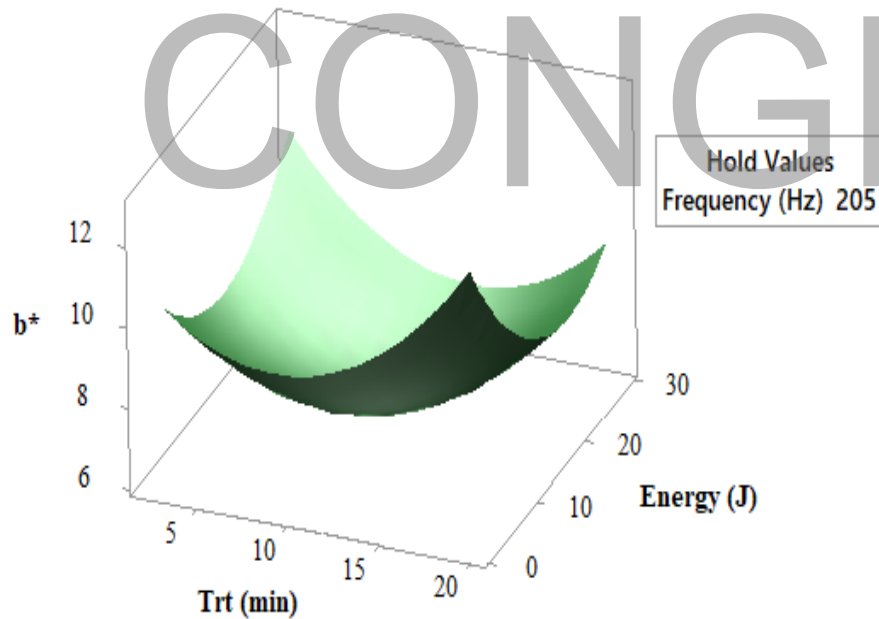
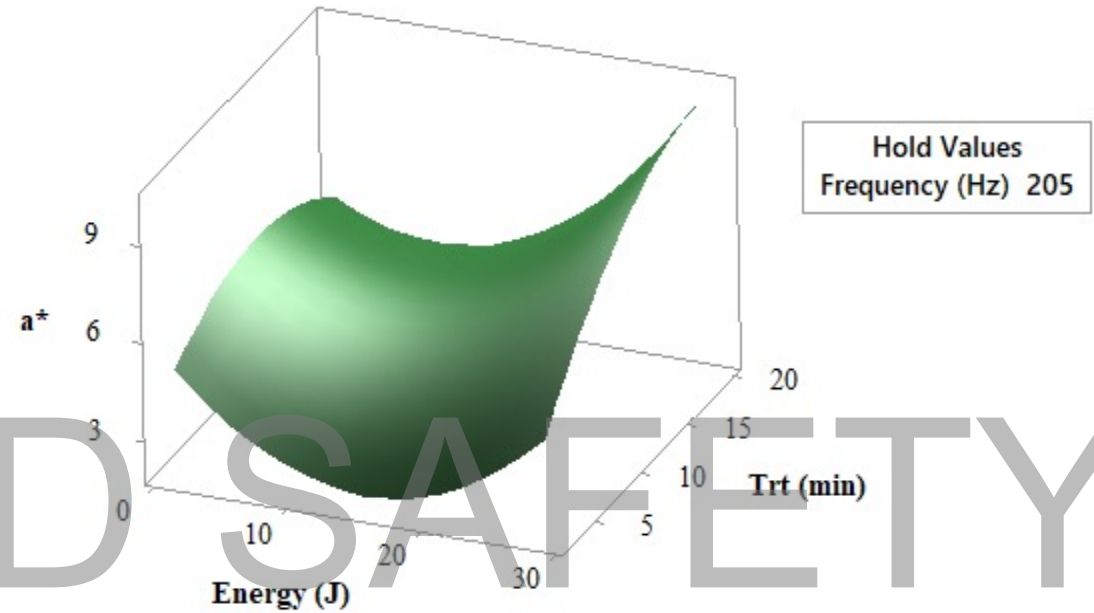
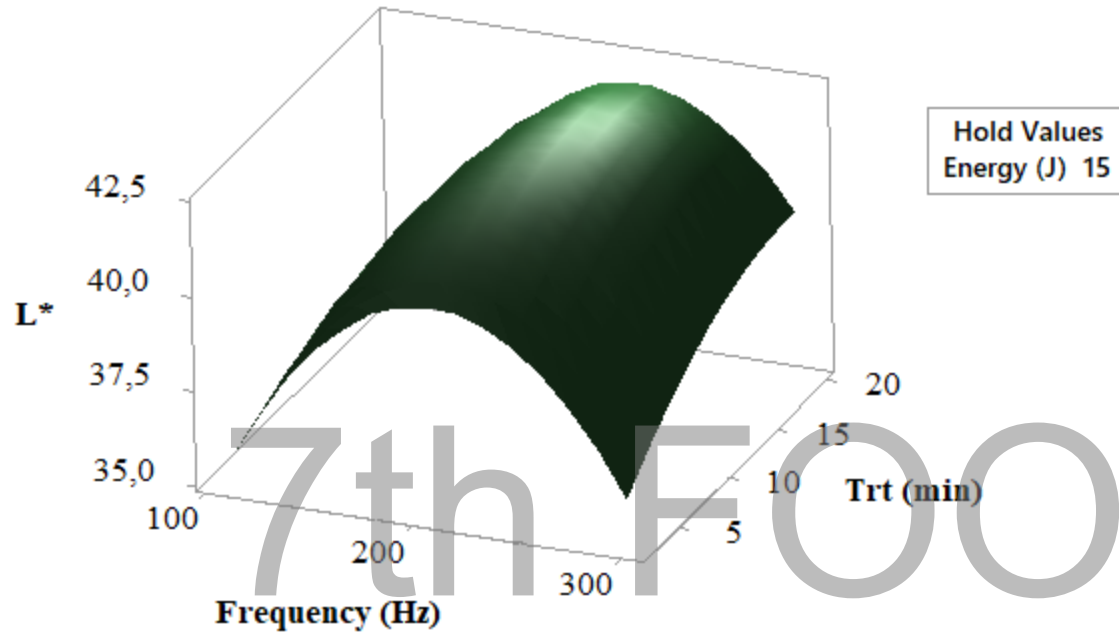
- Total mesophilic aerobic bacteria
- Total mold and yeast
- Total coliform count
- Total Salmonellae



# Results

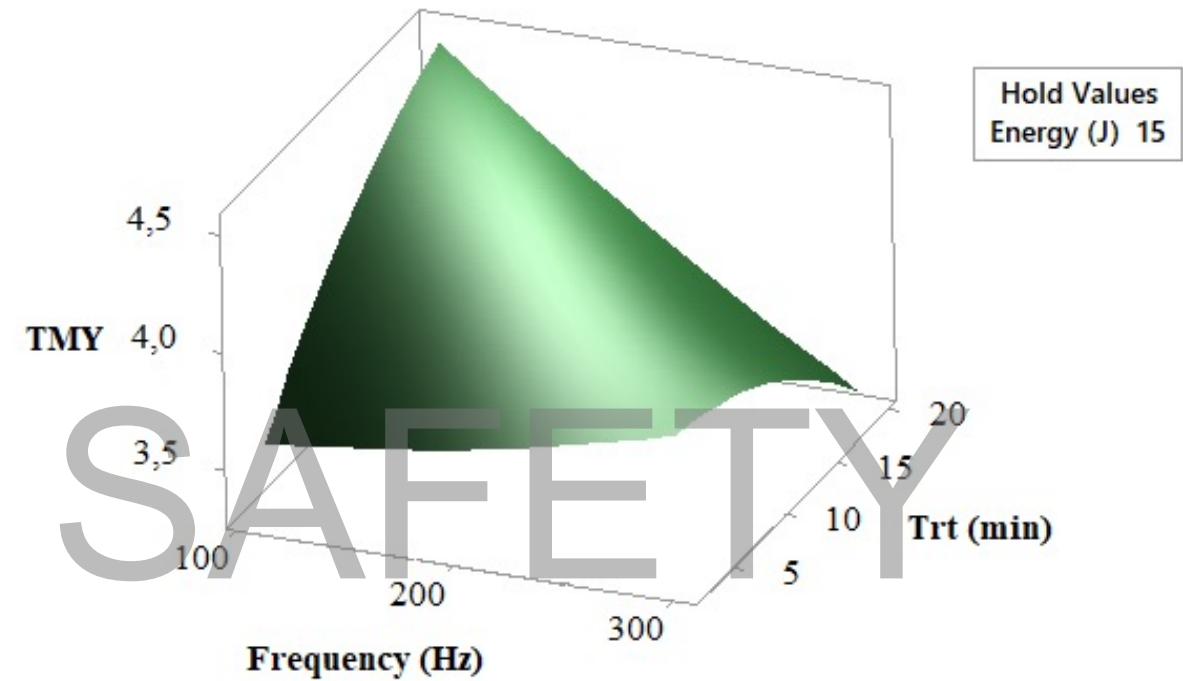
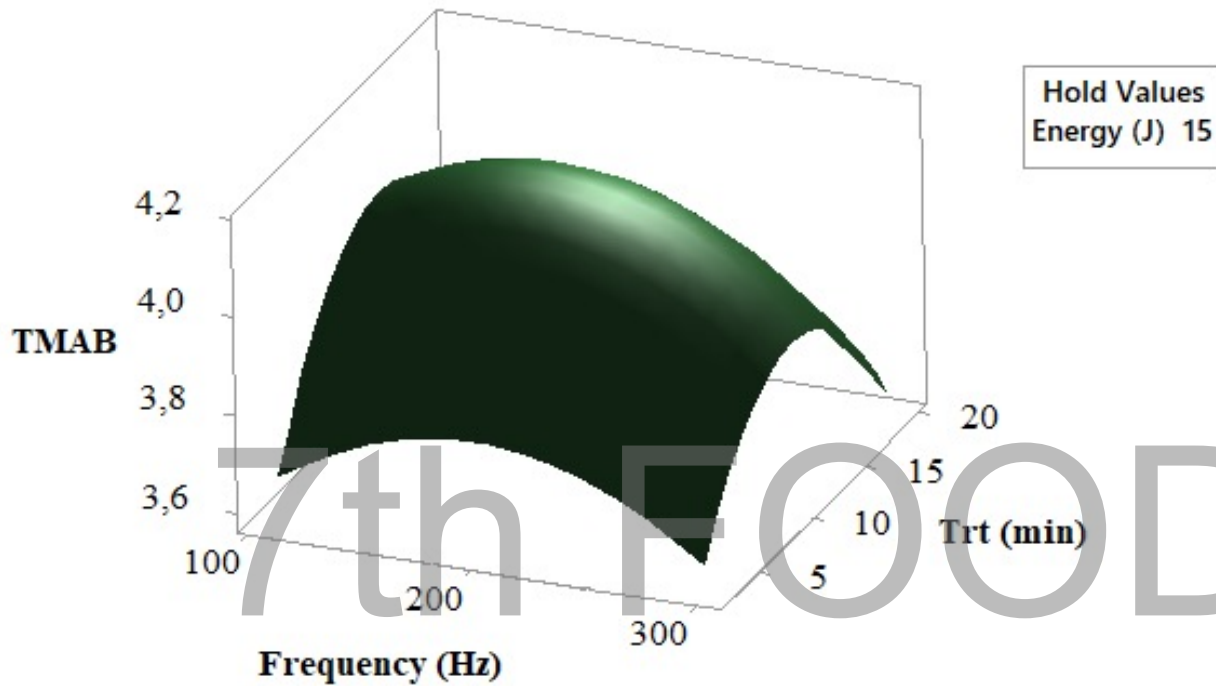


Increase in concentration on total phenolic substance content (TPSC) and total chlorophyll concentration (TC) and total antioxidant capacity



L\* = 0 (black) to 100 (white)  
 a\* = - (green) to + (red)  
 b\* = - (blue) to + (yellow)

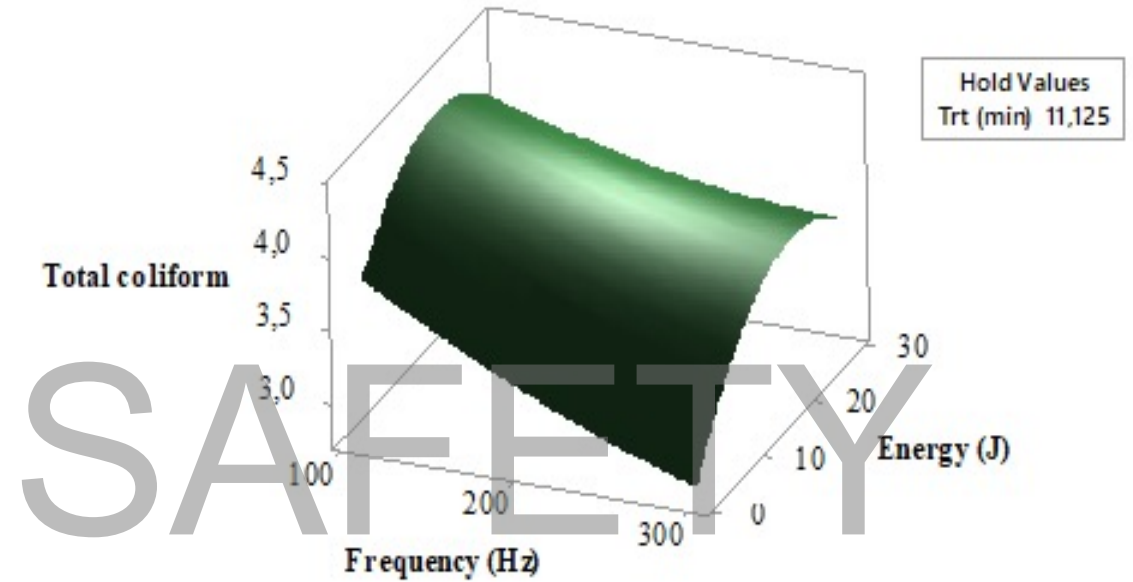
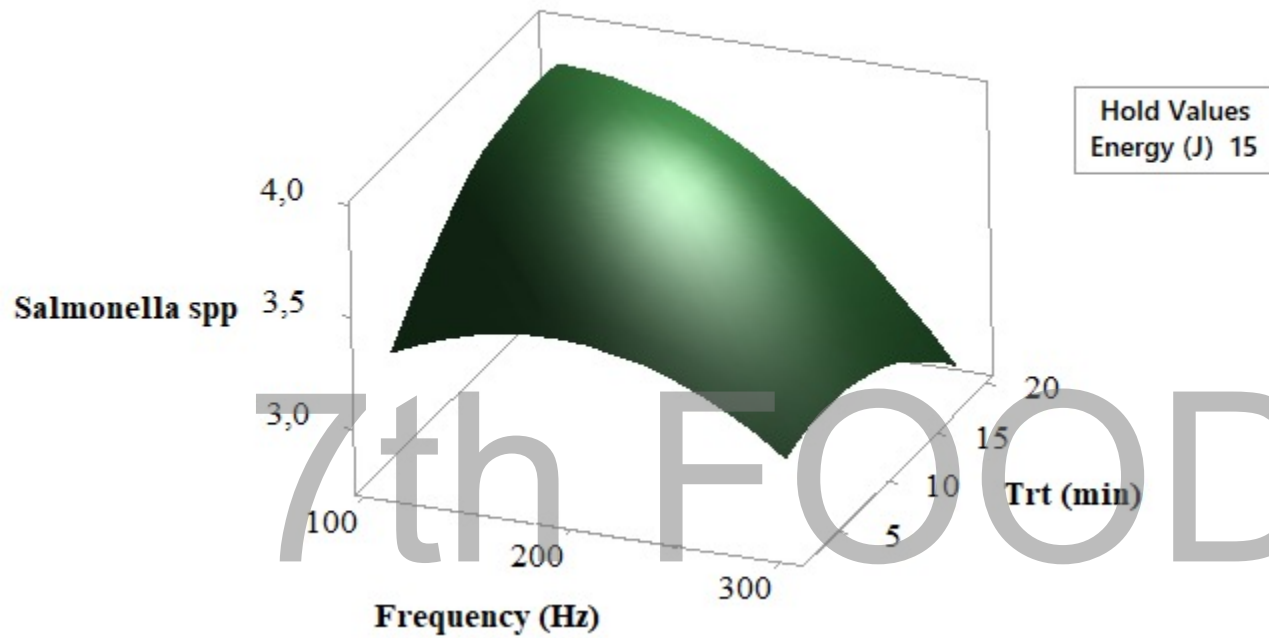
Improved color properties of the pistachio samples with lighter  $L^*$  value meaning no color oxidation; higher  $a$  values meaning more greenish color and  $+b$  meaning yellowish color



**Significant inactivation of microbial counts by increased energy as a result of applied electric field strength, frequency and treatment time**

$$\text{TMAB} = 2,88 + 0,0050 \text{Frequency (Hz)} + 0,102 \text{Trt (min)} + 0,0159 \text{Energy (J)} - 0,000017 \text{Frequency (Hz)} * \text{Frequency (Hz)} - 0,00382 \text{Trt (min)} * \text{Trt (min)} - 0,00103 \text{Energy (J)} * \text{Energy (J)} - 0,000057 \text{Frequency (Hz)} * \text{Trt (min)} + 0,000138 \text{Frequency (Hz)} * \text{Energy (J)} - 0,00012 \text{Trt (min)} * \text{Energy (J)}$$

$$\text{TMY} = 3,08 + 0,0005 \text{Frequency (Hz)} + 0,108 \text{Trt (min)} + 0,0393 \text{Energy (J)} + 0,000005 \text{Frequency (Hz)} * \text{Frequency (Hz)} - 0,00168 \text{Trt (min)} * \text{Trt (min)} - 0,00201 \text{Energy (J)} * \text{Energy (J)} - 0,000464 \text{Frequency (Hz)} * \text{Trt (min)} + 0,000028 \text{Frequency (Hz)} * \text{Energy (J)} + 0,00229 \text{Trt (min)} * \text{Energy (J)}$$



## Regression equations

Total coliform inactivation =  $3,43 - 0,0015 \text{ Frequency (Hz)} + 0,148 \text{ Trt (min)} + 0,031 \text{ Energy (J)} + 0,000009 \text{ Frequency (Hz)}$   
 $* \text{Frequency (Hz)} - 0,00359 \text{ Trt (min)} * \text{Trt (min)} - 0,00267 \text{ Energy (J)} * \text{Energy (J)} - 0,000694 \text{ Frequency (Hz)}$   
 $* \text{Trt (min)} + 0,000124 \text{ Frequency (Hz)} * \text{Energy (J)} + 0,00364 \text{ Trt (min)} * \text{Energy (J)}$

Salmonella spp =  $3,15 + 0,0065 \text{ Frequency (Hz)} + 0,081 \text{ Trt (min)} - 0,0388 \text{ Energy (J)} - 0,000030 \text{ Frequency (Hz)}$   
 $* \text{Frequency (Hz)} - 0,00236 \text{ Trt (min)} * \text{Trt (min)} - 0,00176 \text{ Energy (J)} * \text{Energy (J)} - 0,000269 \text{ Frequency (Hz)}$   
 $* \text{Trt (min)} + 0,000362 \text{ Frequency (Hz)} * \text{Energy (J)} + 0,00213 \text{ Trt (min)} * \text{Energy (J)}$



# Effect of PEF on pistachio nut inner skin

- Strongly bound inner skin to fruit kernel
- Not desired in food industry
- Mechanical or chemical separation from the fruit resulting in breakage or discoloration

- Drying of inner skin by PEF
- Fast and easy separation from the kernel
- More greenish kernel after PEF subsequent PEF treatment
- Economic importance of removing fast and efficient skin removal

# Future perspective

-Mitigation of aflatoxin as well mycotoxin producing *Aspergillus* spp.

-Increase in safety of agricultural products such as seeds, spices and legumes

-Explore mechanisms of aflatoxin mitigation by PEF

-Determination of end products



# Acknowledgements

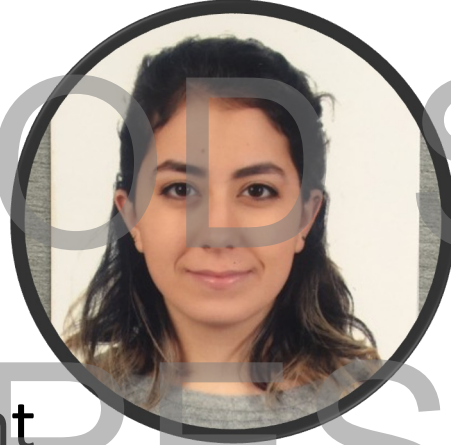
- Funding was provided by BAİBÜ Research Fund (Project no: 2021.09.04.1528) and Adargo Gıda



# TEAM MEMBERS



Şerife Mustulođlu, M.Sc student



İrem Demir, M. Sc. student



Dr. Gulsun AKDEMIR EVRENDILEK





7th Food Safety Congress