



THE INFLUENCE OF SOME CUMINUM CYMINUM L. ESSENTIAL OIL BIOACTIVE METABOLITES, AS ANTIMICROBIAL AGENTS ON THE QUALITY OF COTTAGE CHEESE

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A close-up photograph of several yellow flowers from the Apiaceae family. The flowers are arranged in a flat-topped cluster (umbel) and have a delicate, daisy-like appearance with many small florets. The background is a soft, out-of-focus green, suggesting the stems and leaves of the plant.

***Apiaceae* Lindl./Parsley
Family**

- ◆ 300 to 400 genera and about 3000 species
- ◆ Temperate uplands and rare in the tropics
- ◆ Mediterranean region, Middle East and South east Asia
- ◆ Nearly all aromatic biennial/perennial herbs and having hollow stems
- ◆ Schizocarp nonfleshy fruits
- Essential oils
- Medicinal importance
- Spices

- ◆ Best-known species of particular commercial value:
 - Anise*
 - Cumin*
 - Coriander*
 - Dill*
 - Fennel*

- Cumin - flowering plant in the family Apiaceae
- Native to Egypt and has been cultivated in the Middle East, India, China and Mediterranean countries for millennia
- The fruits, also commonly known as 'seeds' are darker in color with a fusiform shape and each one contain only a single seed



Cuminum cyminum L.

Used in traditional and veterinary medicine

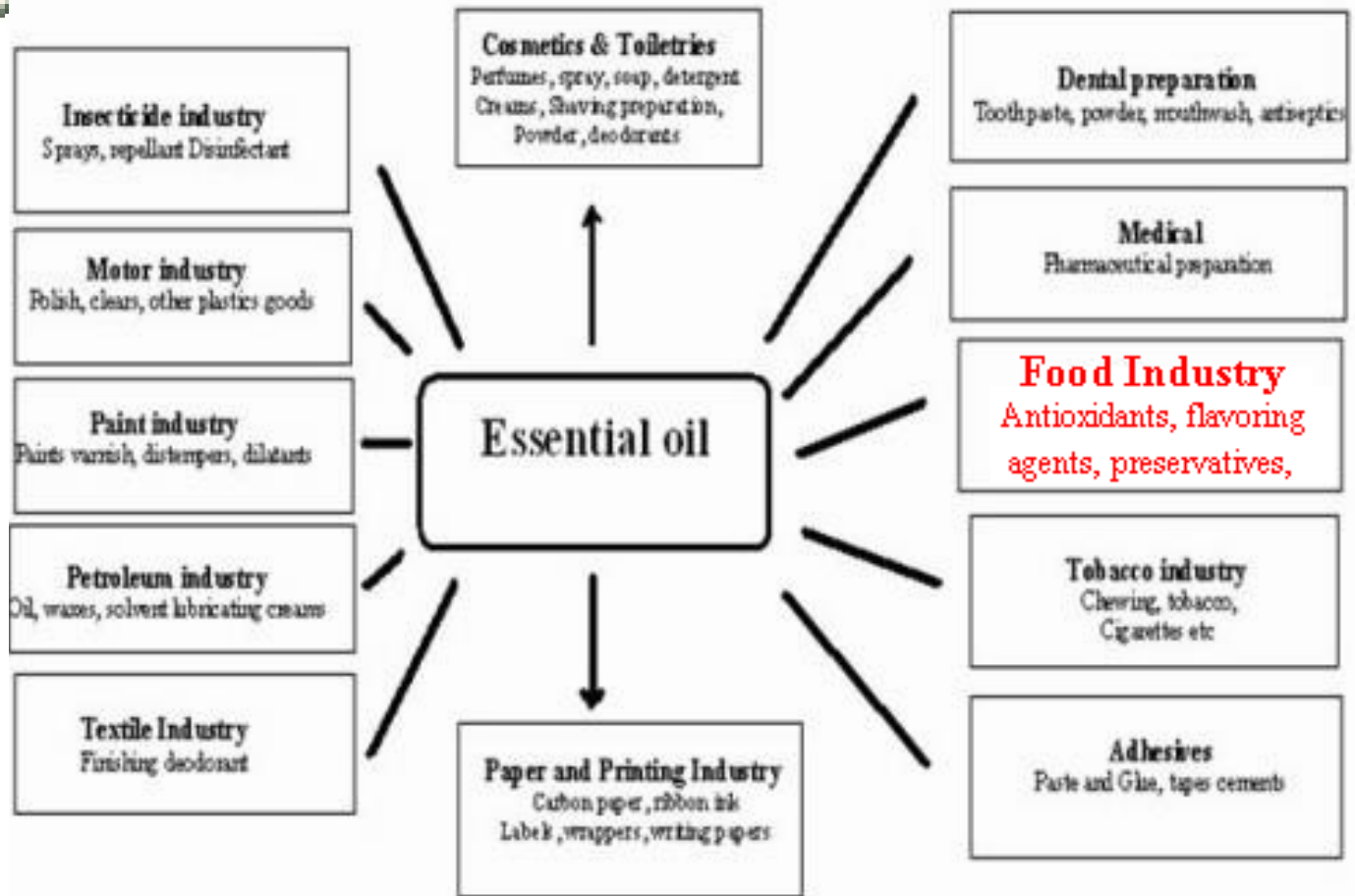
Arabia, India, China and in the countries bordering the Mediterranean Sea – spice condiment in vegetarian and nonvegetarian preparations

Flavoring agent

Pharmacological properties:

- antioxidant activity
- stimulates the secretion of pancreatic enzymes
- antibacterial activity
- antitumor effect
- ameliorates symptoms of diabetes and Parkinson diseases

Essential oils are the most important and effective plant secondary metabolites including many type of biological effects.



ESSENTIAL OIL CONSTITUENTS

Terpenes (*monoterpenes, sesquiterpenes, and diterpenes*) - inhibit the accumulation of toxins and help discharge existing toxins from the liver and kidneys (Kang et al., 2014)

- ***Sesquiterpenes*** - are antiseptic and anti-inflammatory. They work as a liver and gland stimulant and have the ability to surpass the blood-brain barrier and enter the brain tissue (Boaduo et al., 2014)

Oxygenated compounds (*esters, aldehydes, ketones, alcohols, phenols, and oxides*) cause majority of the antibacterial and antifungal action (Carson et al., 2006)

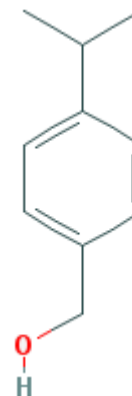
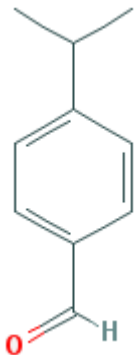
- ***Aldehydes*** - are highly reactive and in general, they are anti-infectious with a sedative effect on the central nervous system. They can be quite irritating when applied topically (citral being one example), but may have a profound calming effect when inhaled (Chang et al., 2013)

- ***Alcohols*** - are commonly recognized for their antiseptic and anti-viral activities. They create an uplifting quality and are regarded as non-toxic. Terpene Alcohols stimulate the immune system, work as a diuretic and a general tonic, and are anti-bacterial as well (Yu et al., 2012; Lee et al., 2005; Reddy et al., 2004)

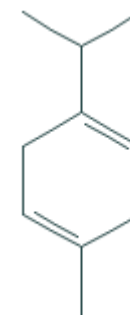
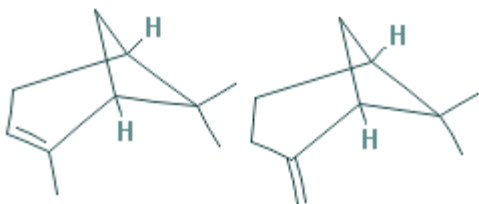
- ***Sesquiterpene Alcohols*** - are anti-inflammatory, anti-bacterial, anti-mycotic, and ulcer-protective

- ***Phenols*** - are responsible for the fragrance of an oil. They are antiseptic, anti-bacterial, and strongly stimulating but can also be quite caustic to the skin. They contain high levels of oxygenating molecules and have antioxidant properties.

- ***Ketones*** - are sometimes mucolytic and neuro-toxic when isolated from other constituents, however they are helpful with such conditions as dry asthma, colds, flu and dry cough



- ❑ Terpenoides: Cuminaldehyde, cuminyl alcohol, in the essential oil
- ❑ Terpenes: α - and β - pinene, γ - terpinene, in the essential oil



Food-borne diseases are those diseases that are the result of exposure to pathogenic microorganisms, such as bacteria, viruses and parasites, which tend to have acute effects on human health.

Milk is ideal medium for growth of pathogens



Pathogen bacteria



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Food – borne diseases can be caused by certain factors, including:

- Food from unsafe sources 12%
- Improper storage temperature 63%
- Poor personal hygiene 28%
- Contaminated equipment 23%
- Inadequate cooking 21%
- Other things 20%

This total is over 100% because of overlapping.

Food safety is defined as “the practical certainty that injury or damage will not result from the food consumed in a reasonable manner”.

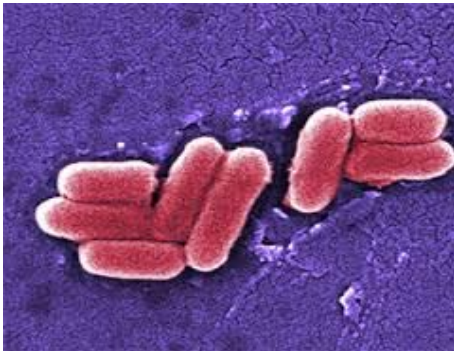




***Salmonella* spp.**



Bacillus cereus



***Escherichiacoli* O157:H7**



Listeria monocytogenes



Campylobacter jejuni



Staphylococcus aureus



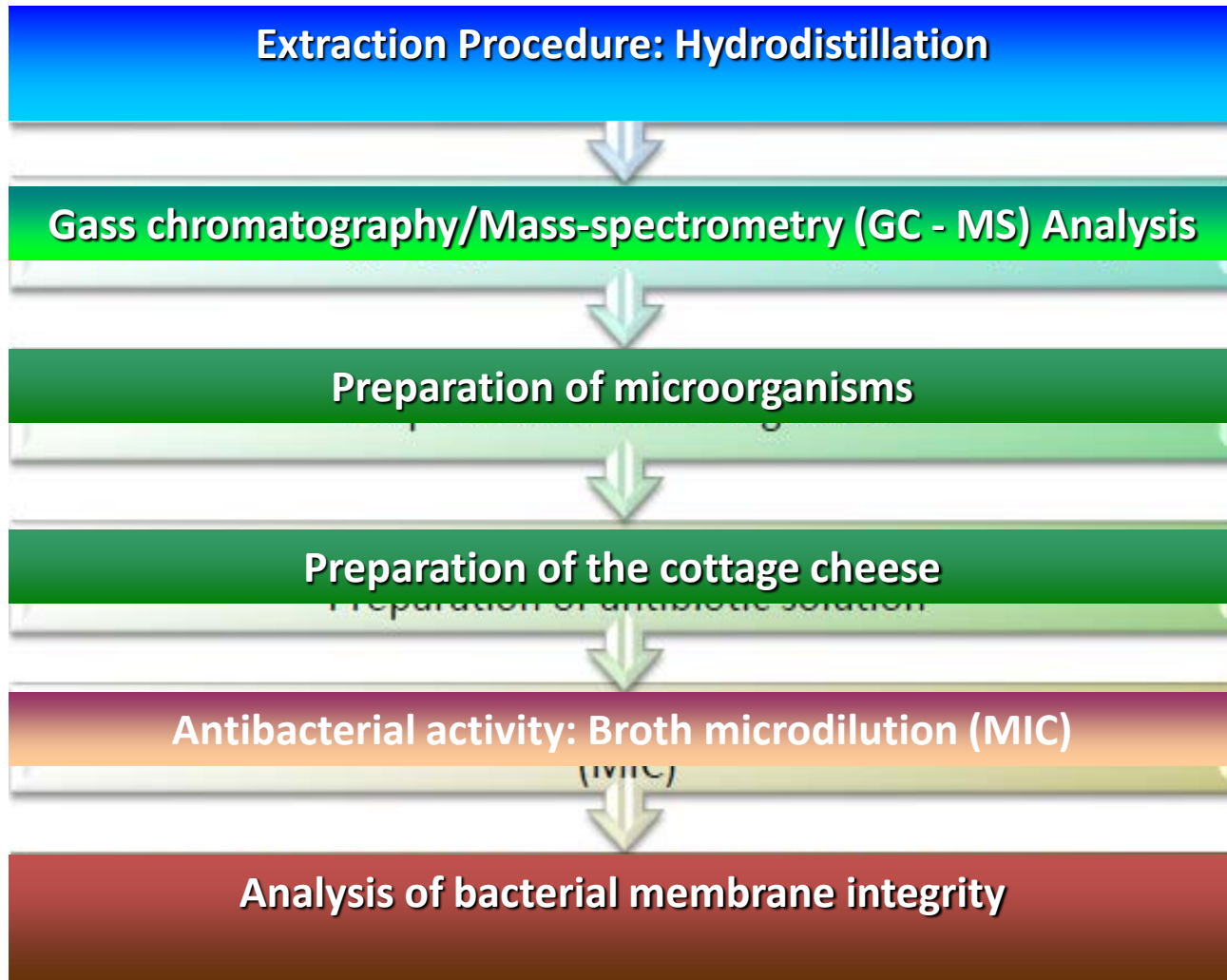
❖ Analyses of the cumin essential oil (*Cuminum cyminum L.*) by GC/MS

❖ Identify the major components

❖ Evaluation the effect of the addition of the oil and its major compound, as a potential antimicrobial agent against some pathogenic bacteria (*Staphylococcus aureus* ATCC 6538, *Escherichia coli* ATCC 8739, and *Salmonella enteritidis* PT4), in cottage cheese, during rippening and storage

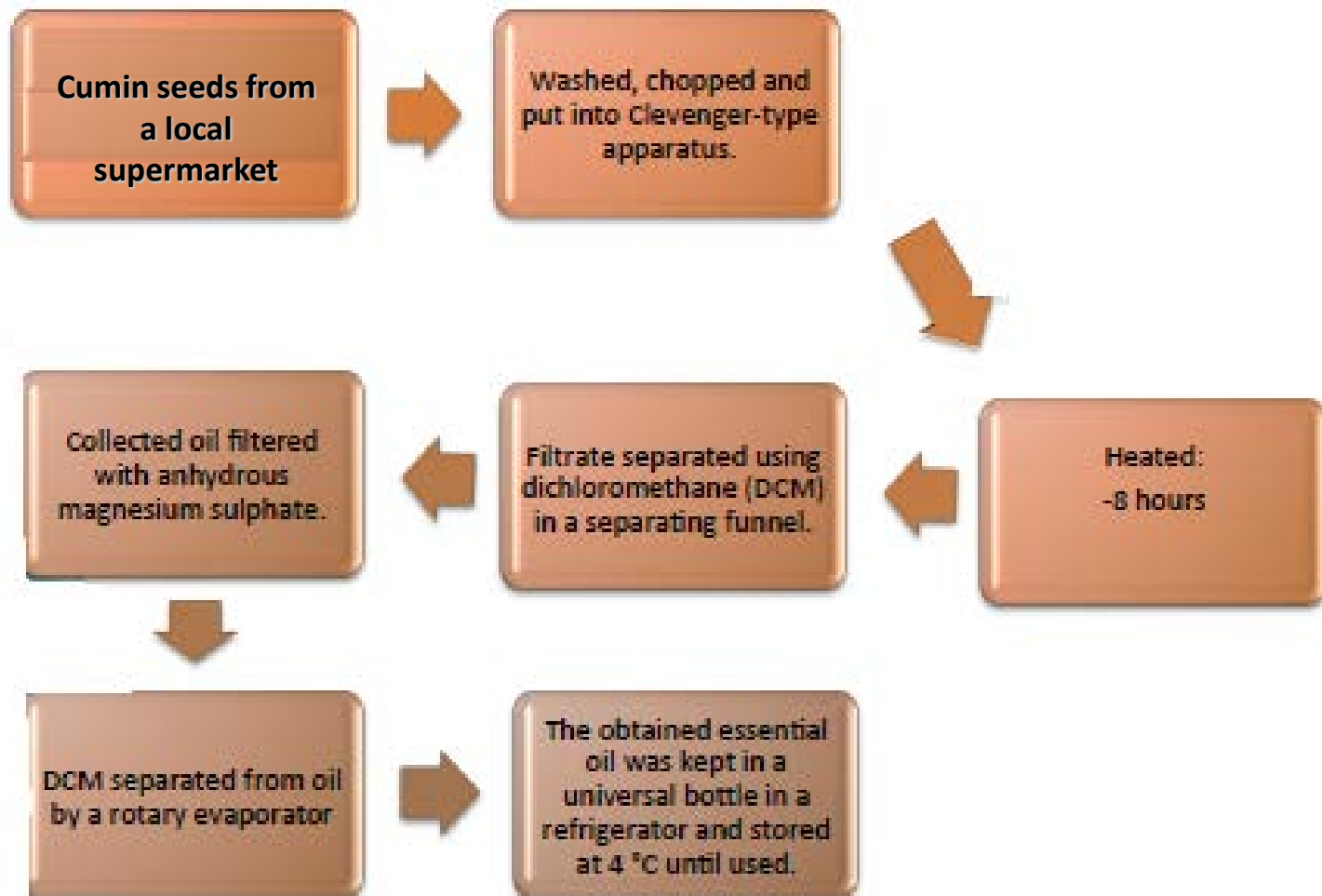


MATERIALS AND METHODS



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HYDRODISTILLATION



MATERIALS AND METHODS

GC – MS ANALYSIS



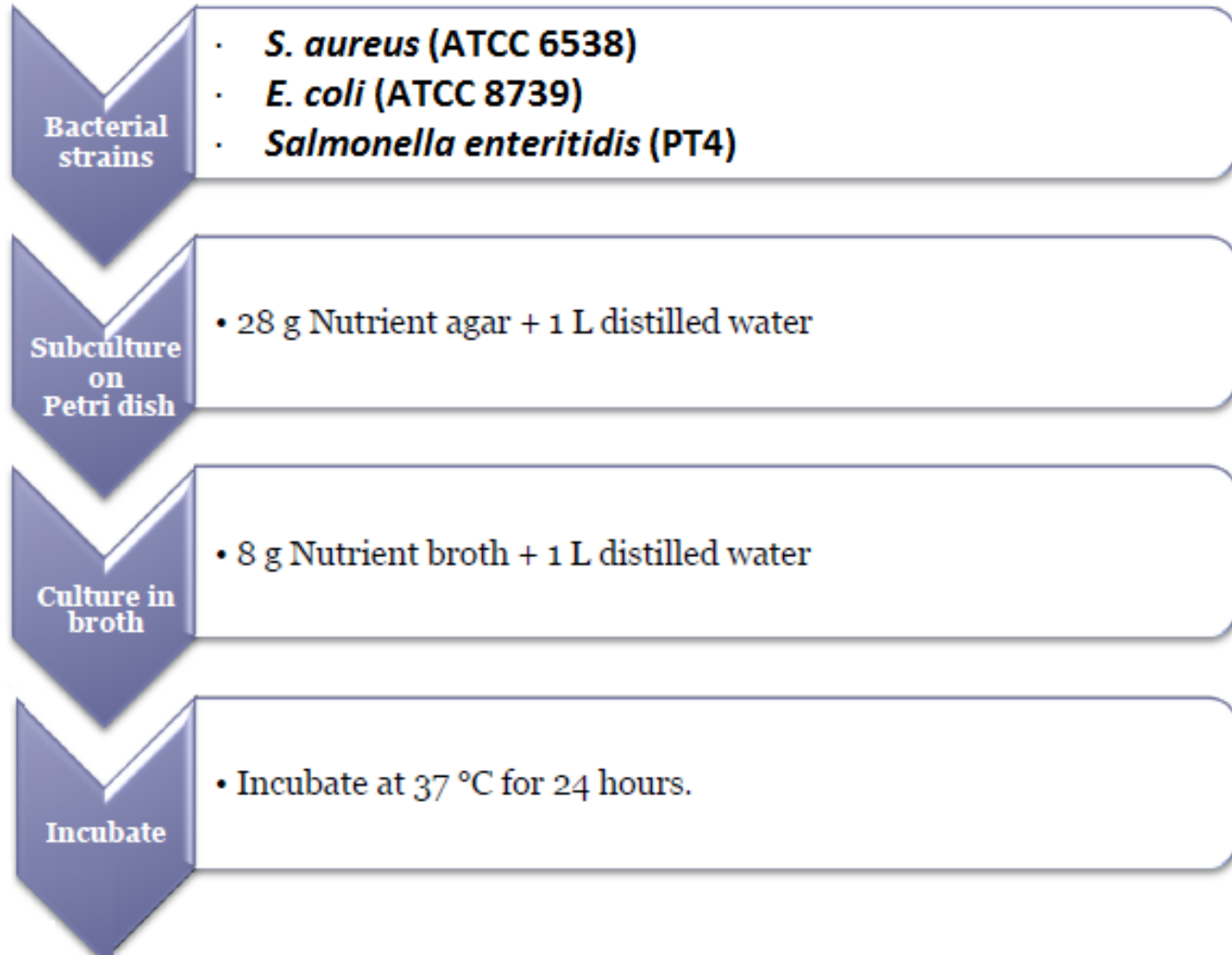
The essential oil components were identified by comparing their mass spectra (MS) fragmentation pattern and relative retention time with the National Institute of Standards and Technology (NIST) mass spectral database library (Kamazeri *et al.*, 2012).

Relative percentage of peak area

$$= \frac{\text{Area of the peak}}{\text{Total peak area} \times 100\%}$$

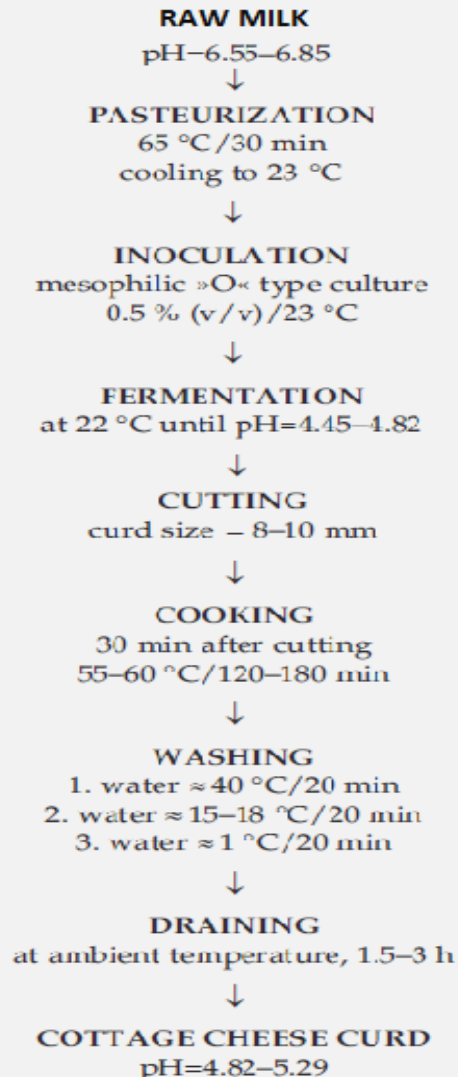
MATERIALS AND METHODS

PREPARATION OF MICROORGANISM



MATERIALS AND METHODS

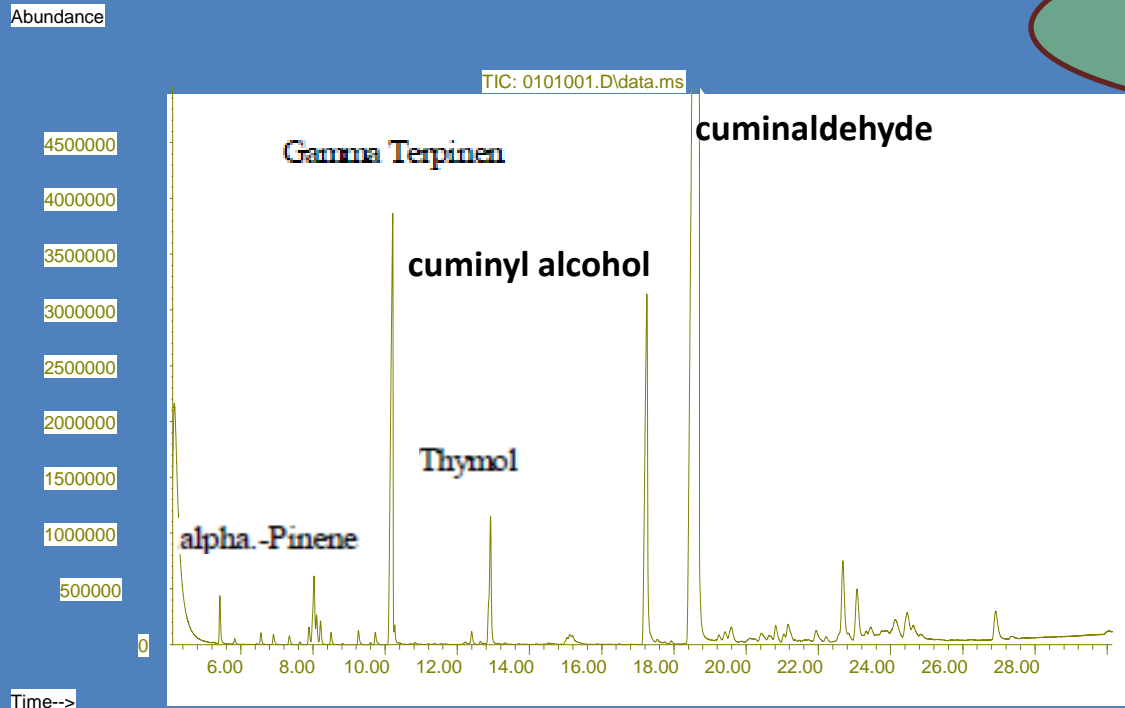
MANUFACTURE OF THE COTTAGE CHEESE



- The parameters for the manufacturing of cheese by the long-set method (4) are presented in Fig. 1.
- Fermentation of 5 L raw milk was performed at 22 °C with 0.5% (v/v) mesophilic starter culture, »O« type (production and without rennet addition).
- Cooking of curd (in water bath) to 55–60 °C was carried out slowly to reach the end point in 120–180 min.
- Before the inoculation with mesophilic culture, the milk was split in 4 equal parts and 3 of them were inoculated each one with tested pathogenic bacteria (10^6 CFU/mL).

RESULTS

In essential oil analysis, identified compounds representing % 94.5 of the oil of cumin. The cuminaldehyde (59.3%) has been found as major component in the essential oil.



The GC/MS analysis of the essential oil from *Cuminum cyminum L* seeds

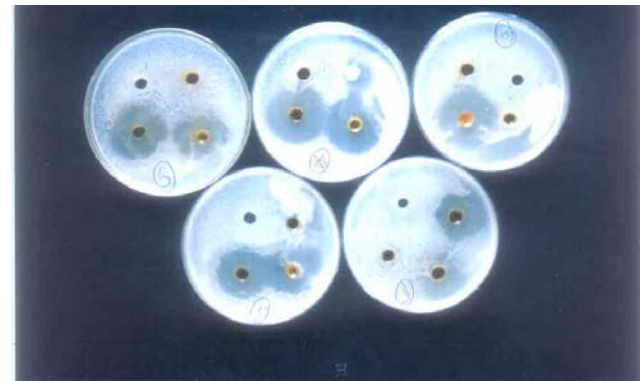
- 44 compounds were identified
- Main components being cuminyl alcohol (21.2%), γ -terpinen (17.3%), thymol (6.6%) α - pinene (2.6%), β - pinene (1.1%).

RESULTS

Minimum Inhibitory Concentration (MIC) of the cumin essential oil and cuminaldehyde

Microorganisms	Essential oil ($\mu\text{L}/\text{mL}$)	Cuminaldehyde ($\mu\text{L}/\text{mL}$)
<i>S. aureus</i>	25.50	30.25
<i>E. coli</i>	75.50	85.50
<i>S. enteritidis</i>	45.50	55.25

Well diffusion method



Antibacterial effect of essential oils /cuminaldehyde on *S. aureus*

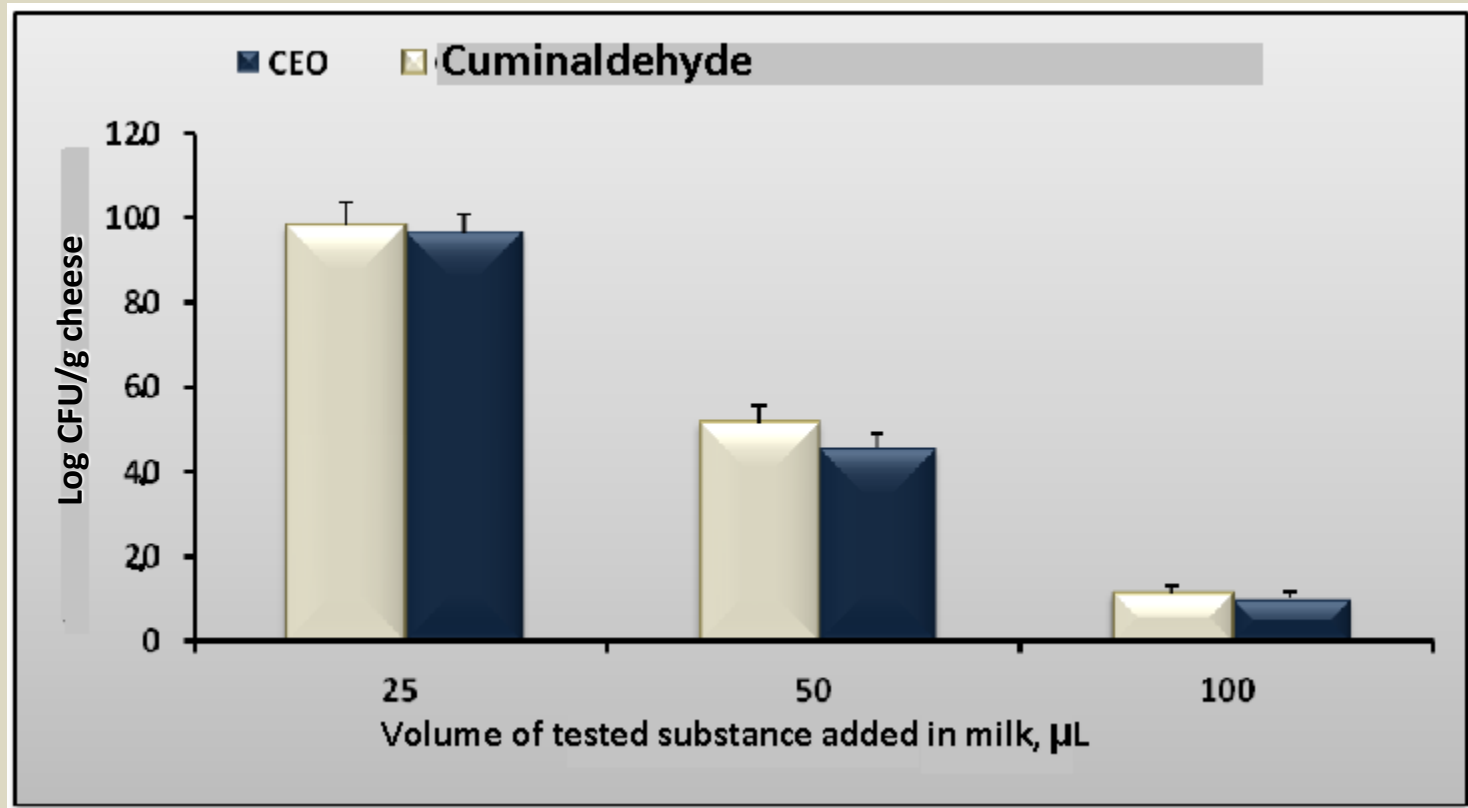
RESULTS

Sensitivity to essential oil/cuminaldehyde -mean diameter of the inhibition zone diameter in mm

Microorganisms	Essential oil	Cuminaldehyde
<i>S. aureus</i>	31.2 ±0.21	25.3 ±0.11
<i>E. coli</i>	19.5 ±0.39	17.2 ±0.16
<i>S. enteritidis</i>	25.3 ±0.31	21.2 ±0.21

RESULTS

Effect of cumin essential oil/cuminaldehyde supplementation on bacterial colonization of Cottage cheese after 21 days of storage



Conclusions

The investigations on antimicrobial activity of cumin essential oils against foodborne bacteria confirmed the potential of this plant volatile oils to be used in Cottage cheese conservation as alternative to chemical preservatives.

Gram-negative bacteria

E. coli and *S. enteritidis*, were less sensitive than Gram-positive bacteria, *S. Aureus*, but the difference in susceptibility were not that evident

Essential oil of cumin mainly consists of oxygenated monoterpenes, 78.3-89.5%,

Future studies are warranted to investigate the synergic effect of cuminaldehyde against drug resistance bacteria



***Thank you for your
attention***

