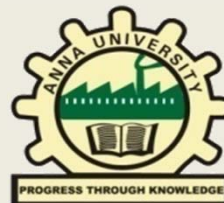


USE AND APPLICATION OF NATURAL PRESERVATIVES

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CONTENT

- Natural Preservatives
- Types and Roles
- Bacteriocins
- Polyphenols
- Synergisms
- Safety Issues
- Conclusion

PRESERVATIVES

- A preservative is a substance / chemical that is added to products such as food, beverages, pharmaceutical drugs, cosmetics to prevent decomposition by
 - Microbial growth
 - Undesirable Chemical changes

Thereby PRESERVING THE PRODUCT

FOOD PRESERVATIVES

Food Preservation is achieved by

- ✓ Physical Processes
- ✓ Chemical Additives

Preservative Additives may be from

- ✓ Natural Sources
- ✓ Chemically Derived

ROLE OF PRESERVATIVES

ANTI MICROBIAL

Bacteria, Moulds, Yeasts

ANTI OXIDANT

Lipids, Proteins

OPTIMAL LEVELS

LOWER A_w

Microbial growth, Chemical
Reactions

STABILIZE

Component interactions

FUNCTIONS OF PRESERVATIVES

- Reduce risk of Food Borne infections
- Decrease microbial Spoilage
- Preserve Freshness
- Retain Nutritional Quality

NEED FOR NATURAL SOURCES

HEALTH CONCERNS

- ✓ Increased Intake of foods with preservatives
- ✓ Inadequate Regulation
- ✓ Hypersensitivity
- ✓ Intolerance/adverse reaction
- ✓ Interactions, cumulative effects

NATURAL ANTIMICROBIALS

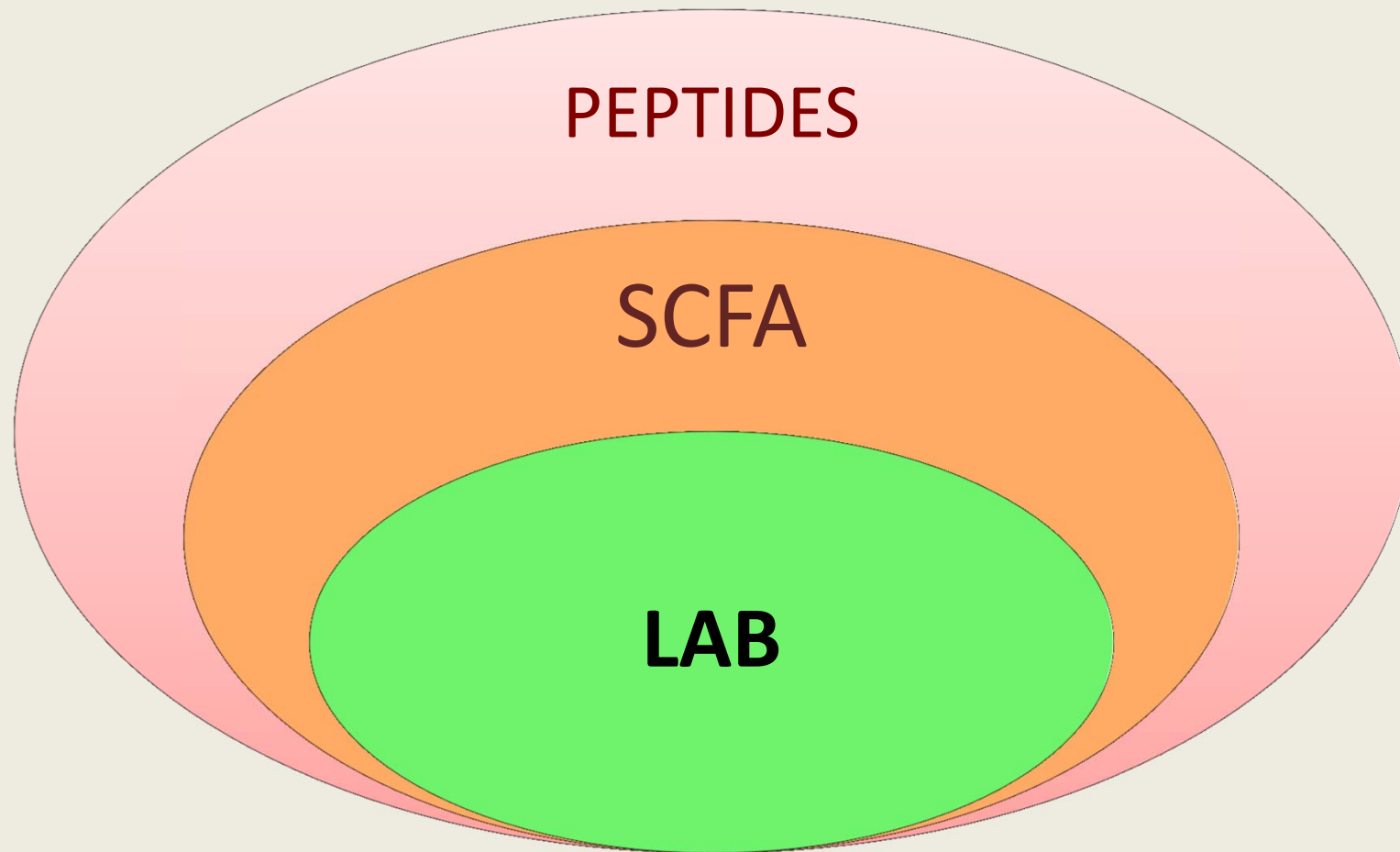
❖ Herbs / Spices and their derivatives

❖ MICROBIAL DERIVATIVES/METABOLITES

❖ Salt

❖ Sugars

PRESERVATIVES FROM MICROBES



BACTERIOCINS AS BIOPRESERVATIVES

- Lactic acid bacteria produce Lactic acid
- Also produce certain antimicrobial peptides known as **bacteriocins**
- Bacteriocins -First discovered by Gratia in 1925
- The term was first coined by Jacob et al in 1953

BACTERIOCINS

- ✓ Antimicrobial peptides, proteins or protein complexes produced by several bacterial species
- ✓ Inhibit the growth of similar or closely related bacterial strains
- ✓ One category of substances produced by bacteria that are inhibitory to other bacteria

Potent inhibitors that offer potential alternatives to
ANTIBIOTICS AND

CHEMICAL PRESERVATIVES IN FOOD

BACTERIA THAT PRODUCE BACTERCINS

- *Lactococcus*
- *Pediococcus*
- *Lactobacillus*
- *Carnobacterium*
- *Enterococcus* and
- *Streptococcus*

BACTERIOOCIN TYPES

SMALL, HEAT STABLE LANTIBIOTICS (Ia, Ib)

Small peptides <5kDA (Nisin)

Globular peptides (Mersacidin)

NON-LANTIBIOTICS (IIa, IIb)

Pediocin A1, Sakacin A & B

Lactococcins G & F

LARGE, HEAT LABILE

Class III, Helveticin

Class IV

Bacteriocins

The most abundant and diverse
microbial defense system

Escherichia coli

colicin

Pseudomonas aeruginosa

pyocin

Klebsiella pneumoniae

klebicin

Bacillus subtilis

subtilin

Staphylococcus epidermis

epidermin

Erwinia herbicola

herbicolacin

Lactobaccillus brevis

brevicin

Halobacteria

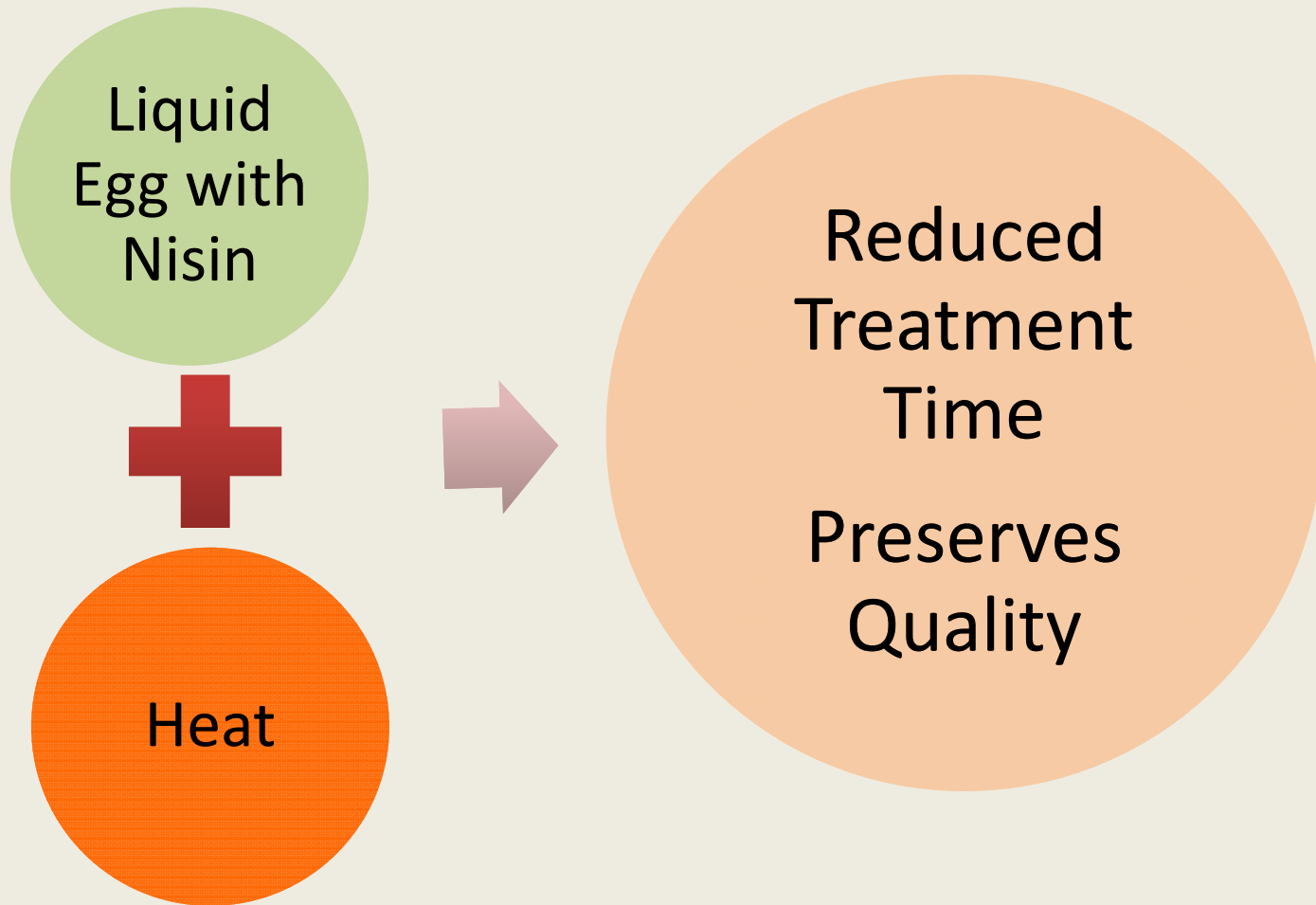
halocin

APPLICATIONS IN FOODS

Three approaches commonly used in application

1. Inoculation of food with LAB produce bacteriocins in the products.
2. Addition of purified or semi-purified bacteriocins as food preservatives.
3. Use of a product previously fermented with bacteriocins-producing strain as an ingredient in food processing.

MORE EFFECTIVE WITH OTHER HURDLES



USES OF NISIN

MEAT

L. monocytogenes

DAIRY PRODUCTS

L. monocytogenes
in Cheese

SEA FOOD

L. monocytogenes
in brined shrimp

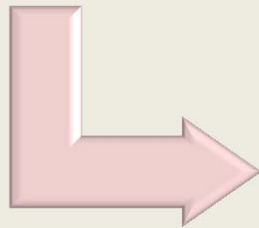
ACTIVITY OF BACTERICINS VARIABLE

Bacteriocins differ greatly with respect to sensitivity to pH

Many of them are considerably more tolerant of acid than alkaline pH values

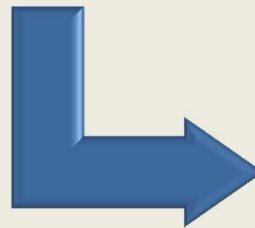
EFFECTIVE IN COMBINATION WITH OTHER HURDLES

BACTERICIN +
HPP/PEF



Bacterial Inactivation

Gram –ve bacteria insensitive
to Lab bacteriocins such as
E. coli O157: H7 and *S.*
typhimurium become
sensitive



ASSURED SAFETY
& QAULTY

OUR WORK

- ❖ LAB Isolates obtained from traditional fermented food *koozh*
- ❖ Antibacterial activity assessed by agar well diffusion
- ❖ Best Isolate grown and supernatant partially purified
- ❖ Efficacy in water melon juice tested

PRESERVATIVE EFFECT ASSESSED

Pasteurized water melon juice inoculated with *E.coli* (10^7 CFU/ mL)



Partially purified bacteriocin (0.05, 0.25 and 0.5 %) was added



After 24 h, the plate count was recorded and compared with the control (without bacteriocin)

Reduction of population/% = (Reduction in microbial count/ total count) x 100

EFFECT IN WATER MELON JUICE

| DOSAGE | ROOM TEMPERATURE 25 C | REFRIGERATION 4 C |
|--------|--------------------------|----------------------|
| 0.05 | 79 x 10 ⁶ | 35 x 10 ⁶ |
| 0.10 | 77 x 10 ⁶ | 23 x 10 ⁶ |
| 0.20 | 68 x 10 ⁶ | 13 x 10 ⁶ |

Control (RT) - 84x10⁶CFU/mL ; Control (4°C) - 42x10⁶CFU/mL

| POPULATION REDUCTION % | | |
|------------------------|--------------------------|----------------------|
| DOSAGE | ROOM TEMPERATURE 25 C | REFRIGERATION 4 C |
| 0.05 | 6.25 | 16.67 |
| 0.10 | 8.75 | 47.23 |
| 0.20 | 18.75 | 69.04 |

ANTIOXIDANTS

Natural antioxidants are widely distributed in plant materials, animal tissues, and microorganisms.

Fruits, vegetables, cereals, legume seeds, oilseeds, teas, and certain spices are important sources of plant-derived antioxidants.

Whole grain cereals provide natural antioxidants

Vitamin E, carotenoids, phenolic acids, flavonoids, lignins, lignans, phytic acid, inositols, folates, microelements (zinc, selenium), melatonin, avenanthramides, and alkylresorcinols

OXIDATION IN LIPIDS

The oxidative reaction is responsible for rancid odors and flavors within fats and oils which reduces nutritional quality of foods.

Oxidation reactions consist of auto-oxidation, photooxidation, enzymatic oxidation and ketonic oxidation, whereas auto-oxidation is the most common deterioration during storage of edible oils.

Autoxidation is the reaction between oxygen and unsaturated fatty acids via an auto-catalytic process consisting of a free radical chain mechanism.

Considering adverse effects of synthetic antioxidants at high concentrations and low thermal stability of them in heat processing and frying of food products, it seems logical to substitute synthetic antioxidants with natural ones.

Many studies performed in the past two decades, show that natural antioxidants which can be extracted from low cost resources with more antioxidant activity and thermal stability than synthetic ones in various edible oils.

Examples include extracts from

- Green tea
- Rosemary
- Olive Leaf

OUR WORK

FINGER MILLET SEED COAT extract rich in polyphenols used in mayonnaise

Preliminary studies –

1000ppm finger millet seed coat (FMSC)

polyphenol

increased oil stability up to 3 months

METHODS

Separation of FMSC (Shobana et al., 2009)

Extraction of polyphenols from FMSC using ultrasonic assisted extraction

Formulation of Mayonnaise
Control (M-C), Standard antioxidant (M-BHT)-200ppm,
natural antioxidant (M-PP)- 1000ppm

Shelf life studies – 15 days, 4° C

Analysis of Physico-chemical properties

PROXIMATE COMPOSITION

| Nutrient composition (%) | M-C | M-BHT | M-PP |
|---------------------------------|------------|--------------|-------------|
| Moisture | 14.12 | 15.11 | 15.09 |
| Ash | 0.26 | 0.3 | 0.4 |
| Fat | 75.48 | 75.77 | 75.1 |
| Protein | 4.04 | 4.1 | 4.01 |
| Crude fiber | 0.18 | 0.21 | 0.18 |
| Total energy (Kcal/100g) | 400 | 401 | 400 |

Texture analysis

Textural characteristics (consistency and spreadability)

- All the samples were uniform, spreadable, and less grainy on day 0
- Properties declined in M-C on day 15 while M-BHT, M-PP were similar to fresh sample
- Raikos et al., (2016) – beet root extract
Incorporated mayonnaise improved the viscosity, hardness, adhesiveness and adhesive force

Consistency

| Days | Sample | Firmness (g) | Consistency (g sec) | Cohesiveness (g) | Index of viscosity (g sec) |
|------|--------|--------------|---------------------|------------------|----------------------------|
| 0 | M-C | 52.39 | 2053.35 | -58.26 | -254.62 |
| | M-BHT | 52.39 | 2053.35 | -58.26 | -254.62 |
| | M-PP | 47.63 | 1886.01 | -51.42 | -220.93 |
| 15 | M-C | 46.38 | 1900.87 | -40.21 | -152.34 |
| | M-BHT | 47.31 | 1980.87 | -51.43 | -200.56 |
| | M-PP | 42.43 | 1800.46 | -42.36 | -190.72 |

Spreadability

| Days | Sample | Firmness (g) | Work of shear (g sec) | Stickiness (g) | Work of adhesion (g sec) |
|------|--------|--------------|-----------------------|----------------|--------------------------|
| 0 | M-C | 31.97 | 17.33 | -27.61 | -11.69 |
| | M-BHT | 12.10 | 12.23 | -29.27 | -6.02 |
| | M-PP | 12.75 | 14.59 | -26.37 | -7.29 |
| 15 | M-C | 25.32 | 10.21 | -20.83 | -6.01 |
| | M-BHT | 8.32 | 10.11 | -25.43 | -3.09 |
| | M-PP | 8.00 | 12.32 | -24.12 | -4.12 |

PEROXIDE VALUE

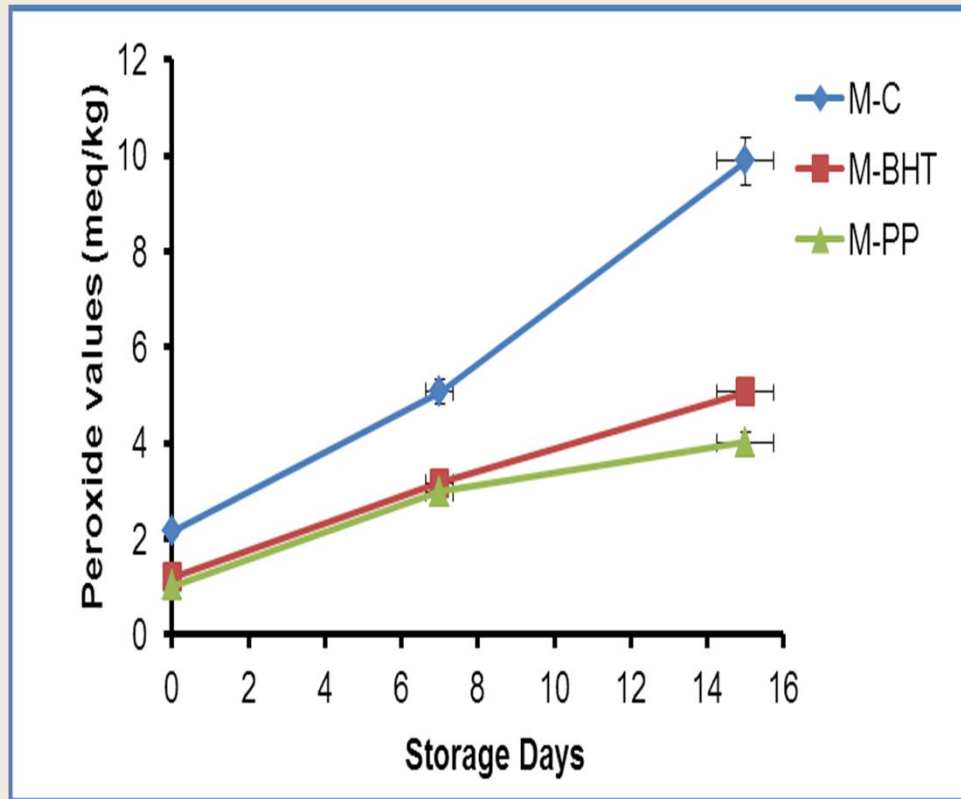


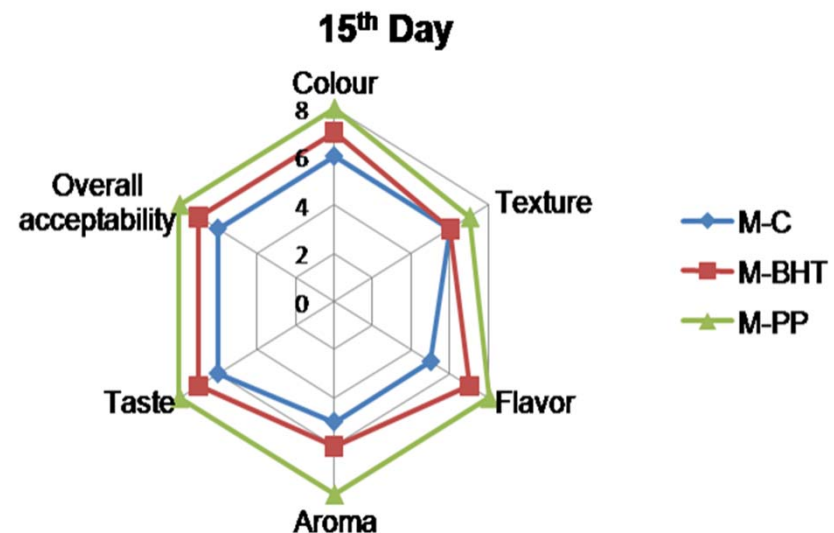
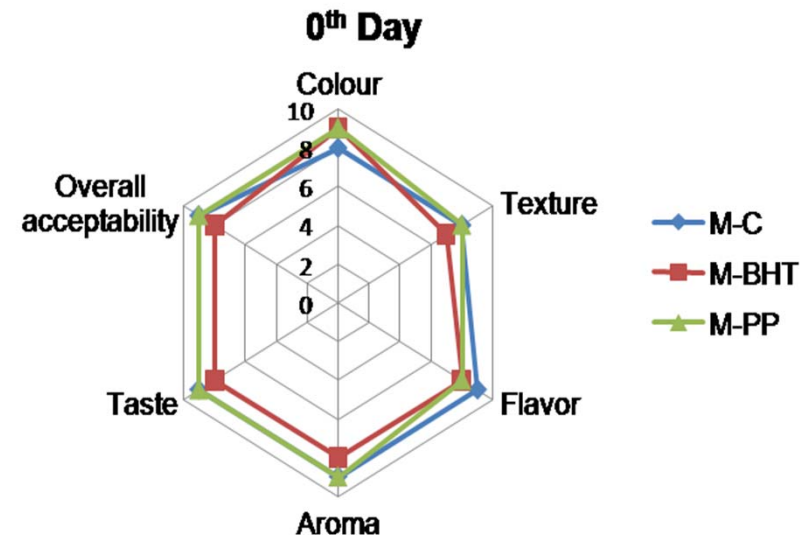
Fig 3 Peroxide values

- PV is correlated with early lipid oxidation, indicator of the lipid oxidation rate
- M-PP had high antioxidant activity retarding peroxidation, than the standard BHT sample

- As expected, oxidation was significantly higher in the control
- Soheir & Heba 2017 - roselle seed oil enriched mayonnaise had a great antioxidant activity attributed to the phenolics present in the oil.

SENSORY EVALUATION

- The objective measures of quality was correlated with the subjective sensory evaluation scores
- Challenging part of using natural antioxidants is to obtain a product with a good sensory properties.
- M-PP (1000 ppm) exhibited similar sensory attributes as control on day 0
- While M-PP was higher in sensorial attributes than BHT

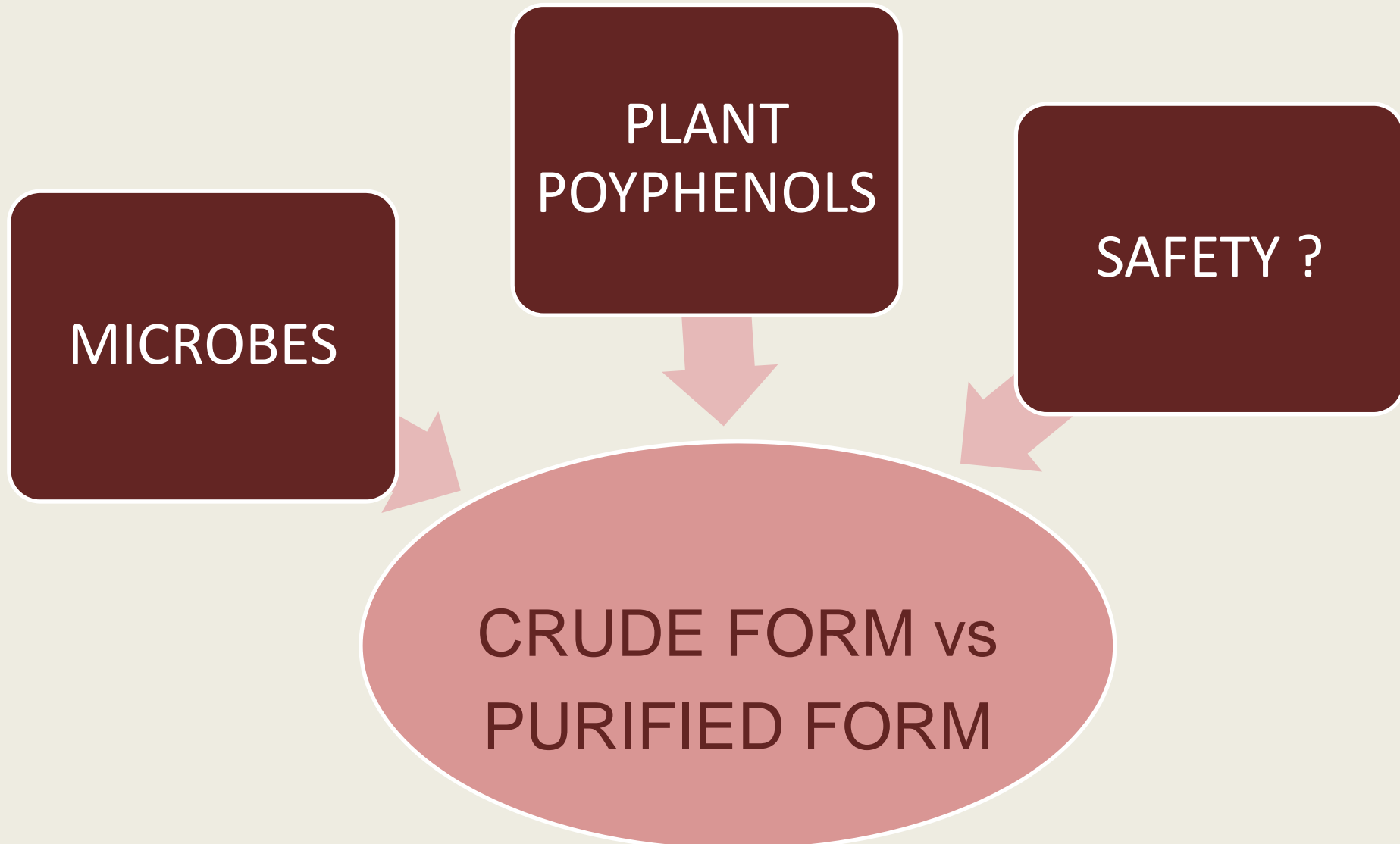


CONCLUSION

- FMSC polyphenol was more effective in retarding lipid oxidation when incorporated in mayonnaise than BHT
- Therefore, FMSC polyphenols are efficient and potent natural antioxidant that can find application in lipid rich foods particularly in mayonnaise and other spreads

REGULATIONS GOVERNING THE
USE OF
SYNTHETIC ANTIOXIDANTS AND
THEIR ADI LEVELS
ARE AVAILABLE
BUT
FOR NATURAL?

NATURAL PRESERVATIVES



FOR SUCCESS- WORK TOGETHER

- Scientists
- Farmers
- Industry
- Government
- Regulatory Bodies
- Academicians



in concert

Thank
you!

