



# Spices and additives

**Mgr. Jana Pokorná, Ph.D.**  
**Dani Dordevic**

Department of Hygiene and Technology of  
Vegetable Foodstuff  
University of Veterinary and Pharmaceutical  
Sciences Brno

# Spices

- in The Czech Republic – law No. 110/1997 Sb. and its ordinance 331/1997 Sb.

Spices  is not food but delicacies

„Ingredients of plant origin mainly used in the preparation of meals and drinks to highlight their taste and aromatic fragrance delivery.“

# Used parts of spices

- the roots and rhizomes
- peel
- leaves and whole plants
- the flowers, buds and other parts of the flower
- fruits and their parts, esp. seeds

- **The underground parts of plants:**  
ginger, turmeric, horseradish, etc.
- **Tree bark:** cinnamon
- **Leaves and whole plants:**  
bay leaf, marjoram, tarragon, savory, basil, oregano, thyme, mint and others
- **Flowers and floral components:**  
cloves, saffron, capers, and others
- **Fruits:**  
anise, fennel, cumin, pepper, paprika, allspice, etc.
- **Seeds and seed components:**  
mace, nutmeg, mustard

# World trade

- 600 000 – 700 000 t per year
- the largest importer of spices is EU (especially Germany), USA, Japan
- the greatest producer is India and it is also the greatest consumer



# The importance of spices

- The initiation of world progress
- Nutritional properties
- Influence on meal acceptance
- Functional properties in certain meals



# The initiation of world progress

- America continent was found due to the search of Indian route
- The reason was **PROFIT**



\$ 4000



\$ 2 100 000



\$ 125 000



\$ 1 700 000

1300 %



# Nutritional properties

- phytonutrients
- Essential oils
- Antioxidants
- Vitamins and minerals



# Functional properties in certain meals

- Better sensoric properties
- Lowering sodium content
  - *Allium sativum*,
  - *Oreganum vulgare*,
  - *Bixa orellana* (Achiote),
  - *Capsicum frutescens*

# The most common spices

- black pepper: 33%
- paprika: 22%
- seeds spices: 15%
- spices from the trees: 14%
- turmeric: 8%
- ginger: 6%
- cardamom: 4%
- vanilla: 2%



**Curcuma  
(turmeric)**

## black pepper (*Piper nigrum*)

- Origin: south India
- Bioactive compound: piperine  
(pungency, bitter taste)
- Health benefits: anti-asthmatic, antioxidant, anti-inflammatory activity, anti-cancer activity.
- In meat products it is decreasing lipid peroxidation



## black pepper (*Piper nigrum*)

- 331/1997 Czech legislation
- Piperine:
  - White pepper > 4%
  - Black pepper > 4%

### Moisture:

- White pepper < 15%
- Black pepper < 14%
- Red pepper < 15%
- Green pepper < 12%



## Paprika (*Capsicum annum*)

- Origin: Central America
- Bioactive compound: n6 fatty acids, tocopherols, carotenoids, vitamin A, E, **capsaicin**.
- Health benefits: antioxidants, reduce inflammation, swelling and pain, blood pressure lowering effect, stimulate digestion



## Paprika (*Capsicum annum*)



- The color: capsanthin, **capsorubin** and beta-carotene
- The method: analysis on spectrophotometer
- Results: color ASTA (American Spice Trade Association)
- ASTA: from 30 to 180.
- Scoville scale (**capsaicin**) for hot food:  
0 to 16 000 000 000 SHU

<https://www.youtube.com/watch?v=2R8QKQwn0IY>

<https://www.youtube.com/watch?v=V57ISv5vJ0c>

## Turmeric (*Curcuma longa*)

- Origin: Southeast Asia
- Bioactive compound: curcumin
- Health benefits: arthritis, heartburn, joint pain, stomach pain, Chron's disease.
- Usage: savory and sweet dishes, taste and coloring



## Ginger (*Zingiber officinale*)

- Origin: Indian subcontinent
- Bioactive compound: **gingerol**
- Health benefits: anti-blood-clotting ability, indigestion and nausea, malabsorption, bacterial infections, fungual infections, ulcers.
- Usage: tea, ginger herbal jello, ginger candy, honey mixture





**Cardamom** (In the culinary arts, cardamom is a spice made from the seed pods of various plants in the ginger family)



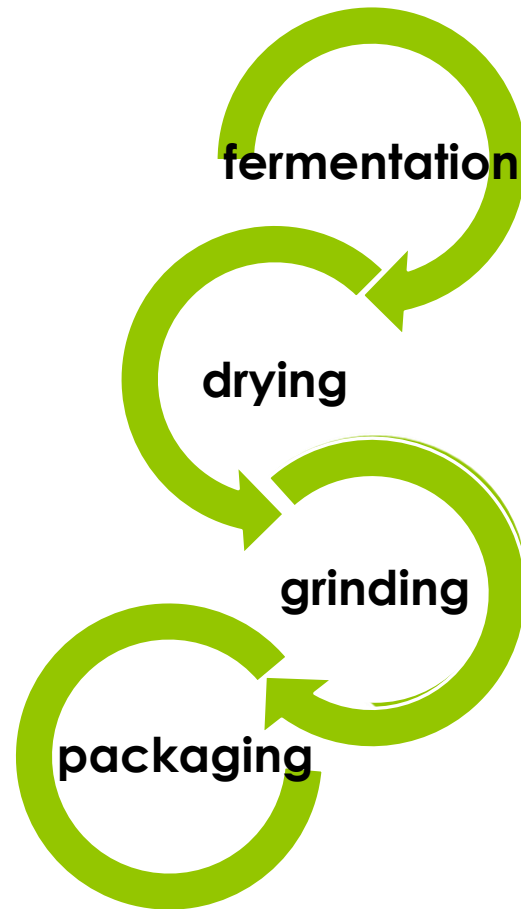
- Origin: India, Malaysia.
- Bioactive compound: eucalyptol
- Health benefits: cardiovascular health, anti-depressant, antimicrobial properties.
- Usage: basmati rice, certain desserts.

## Vanilla (*Vanilla planifolia*)

- Origin: Mexico
- Bioactive compound: vanillin
- Health benefits: antimutagenic, anticancerogenic, antimicrobial properties, antioxidant activity.
- Usage: usually sweet meals



# Processing Technology



# Fermentation

- the essence is the activation of enzymes that catalyze reactions that are accompanied by the characteristic aroma and color of spices and break down the undesirable substances (depending on the type of spice)

# Drying

- as soon as possible after the harvest - **reduction of aflatoxins, moulds, bacteria**, etc.
- **reduces the activity of oxidative enzymes** (esterase, lipase, lipooxidase) - or carotenoids degradation
- ideal - **low temperature, short time**, effects of oxygen
- water content **below 10 %**

# Drying

## Air drying

- freely in a thin layer or in drying very gentle method
- there is a loss of aromatic substances

## Sublimation

- shock-frozen at  $-50^{\circ}\text{C}$  and dried under high vacuum (about 60 Pa)
- dried spices in this way retains its original flavor and color, and texture after rehydration

# irradiation

## Directives 1999/2 and 1999/3

- Irradiation of dried aromatic herbs, spices and vegetable seasonings is authorised at EU level.
- Irradiation must take place in approved facilities.
- Irradiated foods must be labelled.



# Grinding (crushing)

- **for improvement** – durability (shelf life), solubility, release of active substances for extraction
- different types - often tooth - **grinding of pepper 18x**
- temperature spices often **80-100 °C**



# Grinding

## Old method

- between grinding stones → increases the temperature, it means loss of aromatic substances

## Cold milling

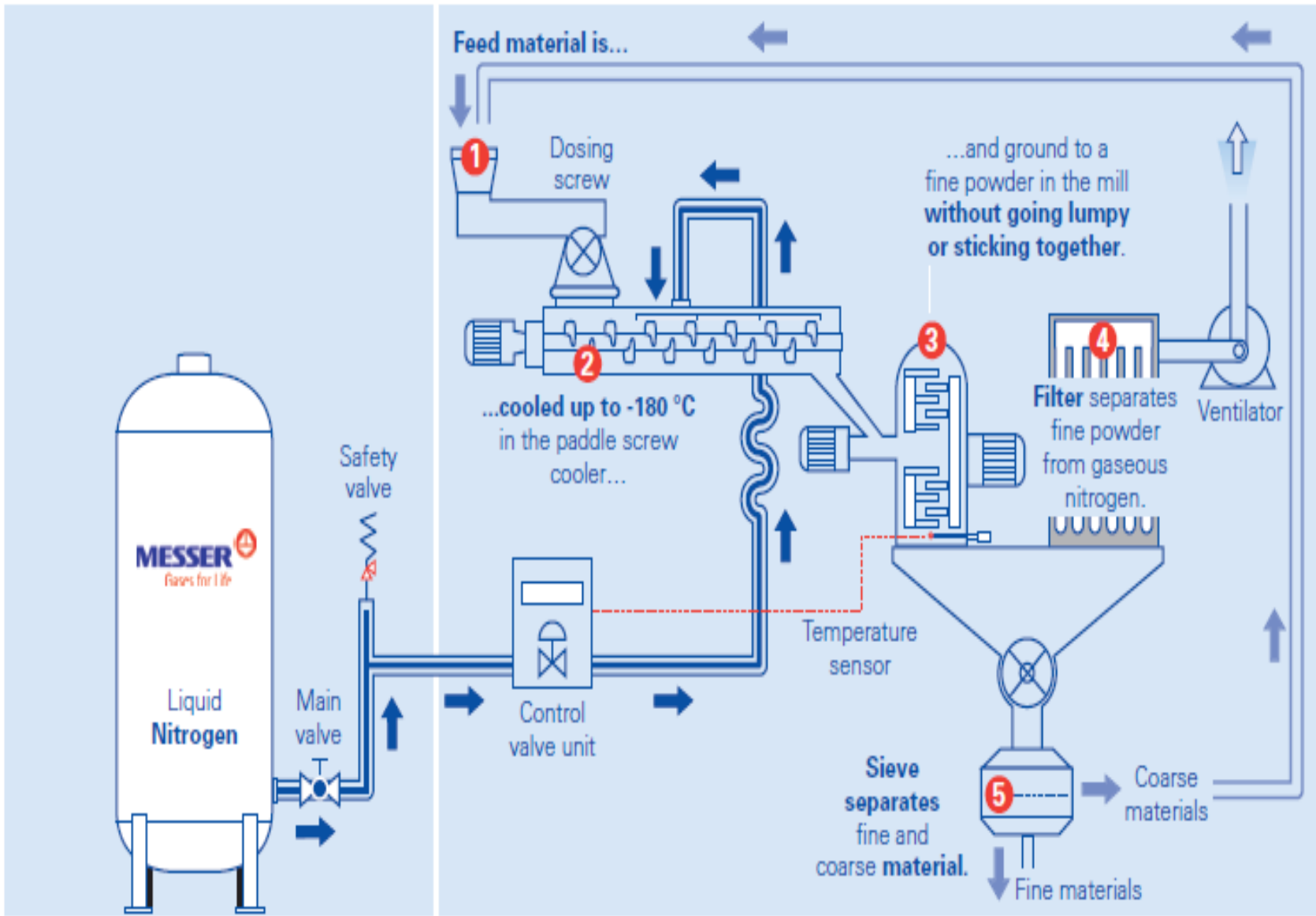
- liquid nitrogen - 85 °C
- minimum loss of essential oils
- costly process

# Cold grinding

- the content of etheric oils and aroma is almost **unchanged**
- oxidation and browning do not show
- increase the efficiency of grinding
- cooling – water, dry air, CO<sub>2</sub>, liquid nitrogen

Spices	without N <sub>2</sub>	with N <sub>2</sub>
<b>pepper</b>	<b>1,4</b>	<b>1,8</b>
ginger	1,4	1,8
coriander	0,2	0,40
caraway	2,9	4,4
Cloves	13,0	15,0

The content of etheric oil



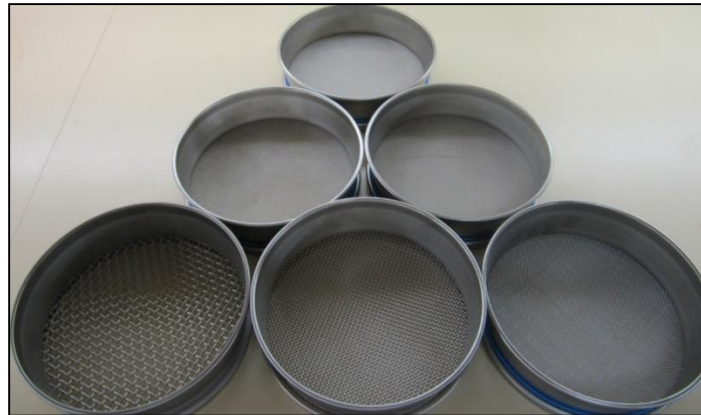
Messer storage tank with Nitrogen

Messer equipment

Grinding mill

Cryogenic technology for product cooling

# Control of minced grind spices – sieves analysis



# Cleaning of spices

- **separation = unwanted** seeds, metal detectors, cyclones, etc.
- a collection of objects found in spices – Raps GmbH Co.



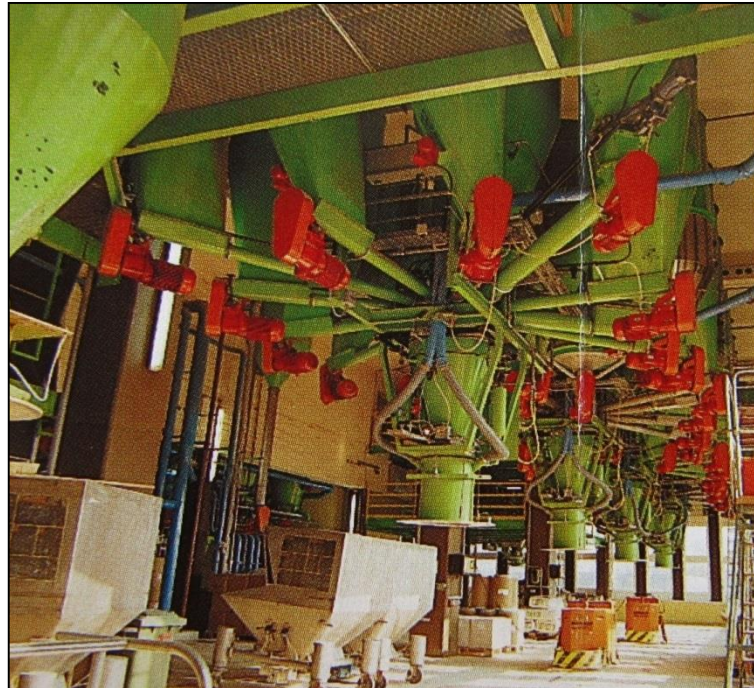
# Packaging

- packed in different containers  
bags from laminated foil materials, glass packaging, containers from different plastic materials)  
→ guarantee a minimum loss of aromatics

Sometimes the spices irradiated radiation, due to the destruction of microbial contamination and animal pests.

# WEIGHING, MIXING

- **automatic weighing** of ingredients in more developed companies
- the quality affect - **prevention from clump**
- the **order of mixed materials**



# Mixing

- different mixes for the meat industry, dairy products - an important schedule of mixing as prevention of unwanted color mixing

**morning white or light-colored spices**

**finally pepper**





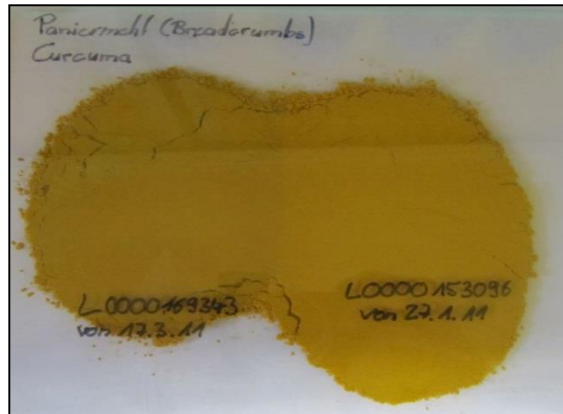
# Cleaning and mixing equipment

- Steam 1x per day, dry way - between batches



# Color control – ground spices

- control with backup samples



# Storage

- **Temperature** - not exceed 23 °C (**Ideal 5-15 °C**)
- **Humidity**  
auto oxidation, Microbial changes  
**creating clumps** – paprika, garlic, onion
- **Light**  
degradation of active **ingredients-Color change**
- **Air**  
oxidative changes in fat, colour pigments  
influence on sensory characteristics
- **Storage time**  
anise is losing 1 % of essential oils per months  
**average loss 10-35 % essential oils/year**  
protection – capsulation



**Spice store by Raps – 30  
tis. dosage**

# Quality control

- **sensory analysis:** appearance, color, taste and smell
- **physiochemically:** moisture, total ash and acid insoluble ash, oil content and impurities
- **microbiologically:** +/- MO

# Spices quality control

- in developed companies is on the first place prevention
- detailed quality criteria are describe in specifications
- insurance of raw material
- the buying trough trade companies: advantages x disadvantages
- supplier is audit by – HACCP, IFS, BRC, etc.



# Spices quality control

## Regulation 882/2004

- Regular
- risk based
- cover all stages of production
- non-discriminatory
- carried out without prior warning



## **Regulation 1881/2006**

- Limits:
  - Aflatoxins
  - Cadmium (0.05 - 0.1 mg/kg)
- Maximum residue levels for pesticides

## **Regulation 1333/2008**

- Sulphites in ginger
- Cellulose and sodium potassium and calcium salts of fatty acids in dried products



1. *Salmonella* control – extracts – no control, spices 1-2x a year
2. *E. coli* testing – rapid-diagnostics
3. organisation of the backup samples
4. colour
5. aflatoxins
6. pathogenic monitoring

# Analyses

- determination of moisture content - distillation method
- determination of volatile oils
- the determination of total ash
- determination of acid insoluble ash
- turmeric - setting power of color - spectrophotometric method
  
- functional compound in spices with chromatographic method

# Identification of spices

- microscopic evaluation
- each spice has its construction and characteristic structure
- for proper identification is needed to know the construction of individual species spices → claims to knowledge of assessors

# Spices and extracts sensory analysis

- Sensory evaluation – commodity experts
- Sensory methods – triangle test, free descriptions
- Evaluation of the final products



# Falsifying spices

- it is intentional or unintentional impairment of quality spices
- the incidence of tissue plants other than declared (substitution of expensive saffron for cheaper turmeric), the presence of foreign particles dirt, dust, sand), use low-quality raw material (e.g. devoid of flavor compounds) this is usually in grinded spices
- detection method: microscopic reviews
- by whole spices: adding spice to the already extracted a quality essential oils to a good quality spices

# What can influence the quality?

The quality is affected by:

1. Origin
2. Climatic conditions (space station)
3. Growing conditions
4. Harvested plant parts
5. Harvest progress
6. Transport
7. Treatment
8. Packaging
9. Storage



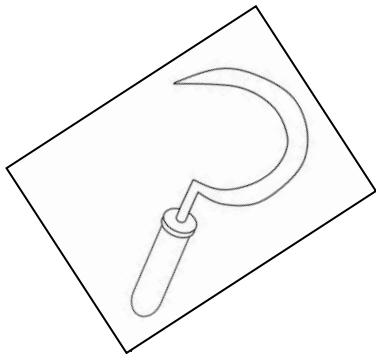
- **Influence of climatic conditions and growing space:**

- **Coriander** - Eastern type has a smaller, more aromatic grain than Moroccan coriander
- **Marjoram** - various media content and geraniol cis-sabinenhydrate (9-40%) is influenced by the place and methods of cultivation
- **Thyme and parsley**, reduced aromatic content with altitude growing – at the a height of 950 m up to 45 %

- **Influence of plant age and the content of aroma substances**

- **Rosemary** – young leaves contain especially  $\beta$ -Pinene, older  $\alpha$ -Pinene

- **significant impact on quality** – level of crushing, yield, microbial purity, presence of dust and other contaminants
- rarely used modern combine harvest – **often is the harvest scythe and sickle**
- transport – weather, separation, pollution etc.





- [https://www.youtube.com/watch?v=wKNk\\_E2tl\\_c](https://www.youtube.com/watch?v=wKNk_E2tl_c)
- <https://www.youtube.com/watch?v=Wz14ZrupUXc>

# Food additives

- Most additives are only permitted to be used in certain foods and are subject to specific quantitative limits
- List should be used in conjunction with the appropriate European Union legislation.
- Food additives are substances added to food to preserve flavor or enhance its taste, appearance, or other qualities.

# Food additives 1333/2008

- Colors (E100 – E180)
- Preservatives (E200 – E285)
- Antioxidants (E300-E392)
- Sweeteners (E400, E900)
- Emulsifiers, stabilisers, thickeners and gelling agents (E300, E400)
- Others

# Food additives 1333/2008

- Sodium Nitrate E251
- Sodium Nitrite E250
- Potassium nitrate E252
- Potassium nitrite E249
- 3.5 mg/kg of body weight, daily intake limit
- They can react with amino acids and form nitrosamines, usually under very high temperatures
- NO (nitric oxide) is formed at the end of curing



*Clostridium botulinum*



nitrate  
nitrite



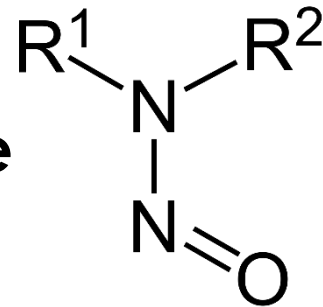
Heat stable  
NO-myoglobin

nitrate  
nitrite

Heat



nitrosamine



nitrate  
nitrite

curing



Nitric oxid (NO)

**Thank you for your  
attention 😊**

