Dry-roasting of nuts using microwaves

How does it work?

Primary objective
To reduce processing time during drying and dry-roasting, and save energy.

Working principle
Since drying is a high energy demanding process, Microwave heating, installed as an assisting treatment of conventional hot air drying process, aims to reduce the drying time and increase the industrial yield.

Hybrid drying processes in the second drying stage of nuts can consist in combining hot air convection and microwave heating (1) in the existing production line, or using a microwave-infrared (Dry-roasting and pasteurization of nuts using infrared heating) combination oven (8). Traditionally drying operation starts just after harvesting to prevent any hydrolytic rancidity and mould development.

Harvested hulled in-shell nuts with a moisture content from 20 to 30% (d.b.) are pre-dried by natural air convection in the field during 3-4 weeks time, till the moisture content is reduced to 10% (d.b.). The conventional second drying stage could consist in a hot air convection in a silo. Otherwise, dry-roasting of nuts using MW can represent a time shortage from 87,5% (hazelnut) to 96,5% (macadamia nuts) of the drying operation, and in most cases the sensorial properties are acceptable (less rancidity).

Images

Additional effects
- Higher production yields
- Lower processing costs
- Improve kernel peeling, that is a major problem for many varieties, especially for Hazelnut

Important process parameters
- temperature, time, frequency, power

Important product parameters
- water activity (aw), moisture content, fatty acid composition, weight, product geometry, dielectric properties

What can it be used for?

Products
- Macadamia nut (1,4,6), Brazil nut (7), hazelnut (8), peanut (2,3)

Operations
- Drying, roasting

Solutions for shortcomings
- Shorting processing times
What can it NOT be used for?

**Products**
High water content (>50%)

**Operations**
- 

**Other limitations**
• Nuts need to be continuously moved in order to avoid the Maillard reaction due to overheating, and to get an efficient and uniform drying.
• Depending on product geometry, uniformity of treatment could be limiting.
• In case large amounts of nuts must be processed, running costs could be unaffordable.
• Although combining hot air and microwave results in a faster process, it could require prohibitively high investment and operating costs (1).
• Even a short period MW heating accelerates the formation of some undesirable and harmful compounds (f.i. oxidation, transformed pigments) (3).

**Risks or hazards**
The magnetrons delivers a powerful electromagnetic field and microwave leakage needs to comply with the regulation.

Implementation

**Maturity**
Though industrial applications of microwaves are applied since the eighties, appropriate processing parameters for industrial dry-roasting need to be tested.

**Modularity/Implementation**
MW heaters can be installed in front of a conventional hot air roasting process in the existing production line.

**Consumer aspects**
Consumers are familiar with microwave heating, due to the domestic use of this technology.
No significant differences between the microwave and conventional drying processes have been found. Some studies have reported nuts with more rancid taste in case using conventional drying. (5)

**Legal aspects**
Please check local legislation

**Environmental aspects**
Energy saving

Facilities that might be interesting for you

<table>
<thead>
<tr>
<th>Title</th>
<th>Institute/company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous microwave heating system with conveyor - SP</td>
<td>SP</td>
</tr>
<tr>
<td>Continuous tubular microwave heating system - SP</td>
<td>SP</td>
</tr>
<tr>
<td>HIGH STATIC ELECTRIC FIELD FREEZER</td>
<td>ONIRIS-GEPEA</td>
</tr>
<tr>
<td>Microwave heating labscale IRTA</td>
<td>IRTA</td>
</tr>
<tr>
<td>Microwave heating pilot and industrial scale IRTA</td>
<td>IRTA</td>
</tr>
<tr>
<td>Microwave system 2450 MHz FBR</td>
<td>Wageningen UR - FBR</td>
</tr>
<tr>
<td>Microwave system 915 MHz FBR</td>
<td>Wageningen UR - FBR</td>
</tr>
<tr>
<td>Radio Frequency heat treatment pilot system - KEKI</td>
<td>NAIK EKI</td>
</tr>
<tr>
<td>Radiofrequency heating semi-industrial scale IRTA</td>
<td>IRTA</td>
</tr>
<tr>
<td>Shockwave - DIL</td>
<td>DIL</td>
</tr>
</tbody>
</table>
Further Information

Institutes
IRTA-Mas Bover, Middle East Technical University, Mansoura University, National Research Centre El Dokki, University of Campinas

Companies
Sairem, Petrie Technology, Stalam, Eodiss Systems, Remak, MEAC, Romill

References

Source: