Microwave heating has an excellent potential for fast and efficient food processing, with large possibilities for reducing energy consumption, while achieving high product quality. The technology can be used separately or combined with existing treatments, and can increase production capacity for a range of purposes, such as heating, thawing, drying, baking, pasteurisation and sterilisation of foods.

We have more than 50 years’ experience in microwave processing for food applications, including:

- Microwave heating, pasteurisation, and sterilisation of ready made meals
- Microwave tempering and thawing of blocks of meat, fish and berries
- Continuous microwave heating of pumpable foods, such as meat emulsions, particulate-containing soups, starch solutions etc.
- Microwave-convective drying of vegetables, fruits and spices
- Microwave baking of cookies, loaves, rolls, and other bakery products
- Microwave scalding of flour, and swelling of starches
- Design of microwaveable foods, to be uniformly microwave heated and to achieve the desired product characteristics
- Microwave puffing of grains (similar to “popping” pop corn)

Advantages of microwave heating

- Rapid heating of foods reduces processing time
- Large potential for reduced energy consumption
- Higher product quality, due to reduced processing time and volumetric heating (less shear forces)
- Increased production capacity and flexibility
- Potential for reducing the acryl amide content in certain products
- Can be used in the development and production of innovative products

Microwaves offer fast and efficient heating of foods by volumetric heating, without the need to heat the surrounding medium, such as air, or the food package. As a result, the transfer of microwave energy to the food, where it is dissipated as heat, becomes very efficient. In this way, microwaves can reduce processing times considerably.

Technology advances have made it possible to develop industrial ovens as well as household ovens into excellent products. Furthermore, modelling makes it possible to develop food products which could be heated more uniformly in the microwave oven.

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SP has leading-edge technology in e.g.:
- Modelling-based process design of microwave heating systems for food applications
- Microwave measurement techniques for determination of dielectric properties
- Design of microwaveable food products, such as:
  - Ready-made meals for uniform microwave heating
  - Design of bakery products for uniform microwave baking, for example short-breads, cakes, and rolls.
  - Scalding of flour, swelling of starches and much more

SP has a well-equipped laboratory with both pilot-scale and lab-scale equipment, for practical trials, and a broad network of partners including suppliers of equipment, packaging solutions, and microwave components.

**Real-life case 1: Shorter baking time and reduced energy consumption**
Companies within the bakery industry were interested in reducing the energy consumption and processing times in their baking lines. A combined microwave-infrared process in lab-scale cut energy costs to about 25% as compared to conventional baking. For bread loaves and rolls, the processing time was cut to about 1/3 of the baking time for conventional baking (e.g. from about 18 minutes to 6 minutes for a tin loaf). As a result, there is a possibility to increase the throughput of products, but also to reduce production space.
Similarly, post-drying of e.g. crisp rolls can be made considerably faster by using microwaves combined with convection. The reduced drying time means reduced need for production space.

**Real-life case 2: Reduced drip-loss when microwave thawing frozen blocks of food**
A company wanted to increase product quality and production capacity, by using microwaves for thawing of frozen food blocks. The technology was tested close to production, and reduced drip-loss during thawing, with resulting advantages from quality as well as cost perspectives.

**Real-life case 3: Optimisation of heating uniformity improves product quality**
A ready-made meal company experienced problems with non-uniform heating of their ready-meal products. SP optimised the dimension and geometry of the microwavable food container, as well as the placement of the individual food components, in order to achieve a more uniform heating. The optimised ready made meal was evaluated after microwave heating, using infrared thermography, and showed significantly improved heating uniformity. The product quality was considerably improved.

**New applications**
- **Continuous microwave heating of pumpable products**, such as particulate foods (for example a soup containing pieces) has given very good results. Direct heating means that the pieces can be heated much faster as compared to conventional treatments, while at the same time the food product is subject to much less degree of shear forces. Reduced processing time and less mechanical shear contribute to minimal processing of particulate food products. A pilot-scale equipment for process evaluation is available in SP's pilot hall.

- **Microwave baking of bread products**, such as tin loaves and rolls, has resulted in considerably reduced baking time and thus reduced energy consumption. Microwave baking can also be combined with infrared waves, impingement or convection, to create the desired product quality.