NEW MACHINERY FOR POPPING SMALL SEEDS

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ABSTRACT

Amaranth is a pseudo-cereal, distinct from wheat and maize. Domesticated amaranth is used as leafy vegetables, seeds, forage and ornament. Amaranth grain has protein that is high in lysine, which is usually lacking in cereals.

Amaranth grain can be put to many uses: it can be ground, parched, roasted and popped. There is little gluten in amaranth flour; therefore it's ideal for those, who suffer from flour allergy. We can bake breads containing 18% amaranth flour. Baked in automatic ovens they suit Hungarian taste. Our objective is to increase the choice of milling industry products. Quality products need new technology or the adjustment of the existing equipment.

The technology process needs an all-round mechanization. Our tests have been conducted at the Agricultural Machinery Department of the Nyíregyháza College. We tested a new popping procedure and we developed a new machine for amaranth popping. Our results are good, we managed to produce quality popped amaranth, which can be used as a basic food for other food industry products. The popped amaranth is used in breads, confectionery products, healthy food. New tinned and food industry products are being developed (e.g. infant foods).

Our successful tests involve the whole technology process and machinery, a reference plot, the processing of amaranth grain, tests of the nutritional values of amaranth, new healthy food products (bakery goods, confectionery products, infant foods).

KEY WORDS: *mechanization, technological development, amaranth seed, popping temperature, flow velocity of the air, humidity, machine for amaranth popping.*

INTRODUCTION

Amaranth is such a prospective plant. Amaranth grain requires special sewing, cultivation. It's clear from the above mentioned, that it's essential to develop cheap machinery.
Our objectives are based on tests with growing amaranth to build the complete machinery, grow amaranth on a reference plot, and produce semi-prepared food.
The most difficult procedure of amaranth growing are sewing and harvesting. Small-sized amaranth grains need special equipment.

Research was done in a complex way starting with sewing and ending with semi-prepared food production.

Planting and harvest cause problems in small-scale farms. Planting needs a special machine because of the size of the grain. In trials we have proved that plate seders, or seder of our construction can be used.

We apply new technology in harvest. We harvest amaranth in two phases. We designed a threshing-cleaning equipment for a research institute, and tested it with cut and pre-dried amaranth. This equipment is likely to become a key machine in amaranth growing if it will be adapted to small-scale farms.

Technology for growing amaranth was developed. We suggested technology for drying amaranth raceme, the height of the flower was determined in the function of velocity of air blast, and a diagram was drawn. To determine the humidity of amaranth seeds a DICKEY-JOHN equipment was added.

RESEARCH METHOD

The possible utilization of amaranth seeds was studied, new models of popping both in practice and theory were worked out, followed by tests with the new popping method. They were carried out in a wind tunnel transformed for the purpose at the Agricultural Machinery Department of the Nyíregyháza College. (Fig. 1)

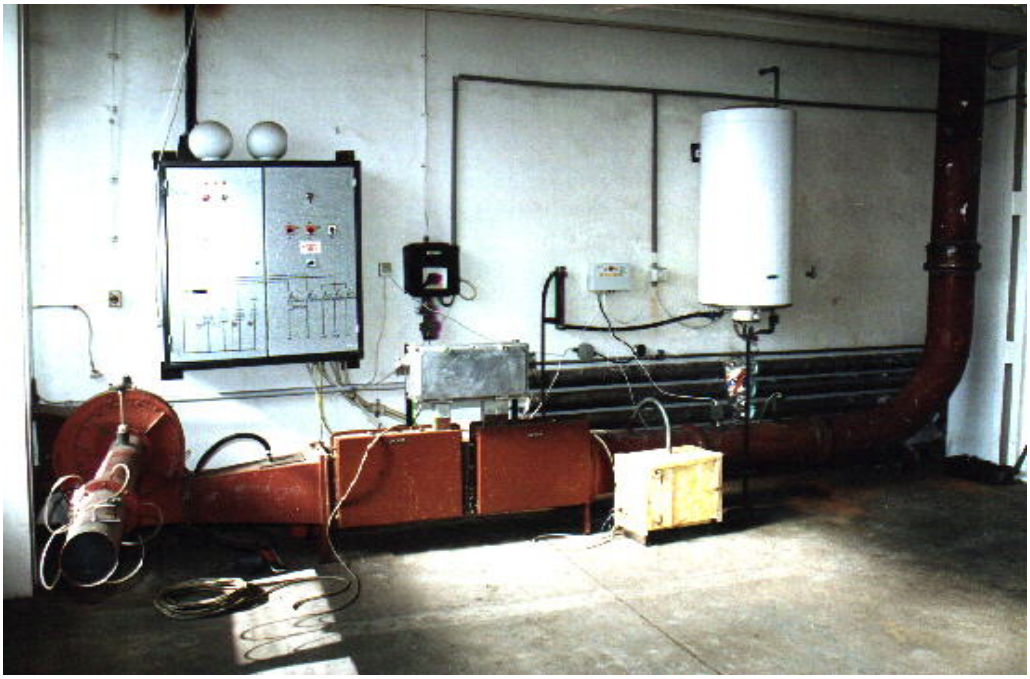

Fig. 1. Wind tunnel, Agricultural Machinery Department, Nyíregyháza College.

Small seeds popping devices were designed.
Comparative tests of popped amaranth with raw seeds showed, that the semi-prepared produce did not lose the favourable properties of the raw seeds.
Our tests contain, an experimental technology for popping, which includes:

- a mathematical analysis of the stages of popping;
- a determination of parameters to ensure optimal volume extension;
- to develop and design new machinery for popping small seeds.
- to determine the nutritive values of both raw and semi-prepared amaranth to prove the merits of the new popping procedure.

Modelling

Prior to popping tests computer modelling took place. The tests depend on many factors: air velocity, popping temperature, humidity content of the seeds, popping time.
The popped seeds should possess good flavour, taste, appearance, and the greatest possible volume-extension of the seeds must be achieved.
As a result of the research, we have one program:
The program is engaged in:

- the simulation of wobble popping,
- the calculation of air velocity,
- the study of the literature so that it could serve as a comparison to our measurements,

Popping tests with contact heat

The first popping test we make with contact heat – and we came to the conclusion, that that way of popping small seeds is not possible.

Popping in a wind tunnel.

After completing the test, we started testing popping in a wind tunnel. The tube section of the popping area was changed to suit our purpose.
The test was as follows:
We set the temperature at the temperature regulating unit of the wind tunnel and the proper air velocity on the valve of the suction tube. The seeds were fed into the popping area.
Experimental parameters: popping temperature, popping time, volume extension humidity of grain. Tests were conducted at various temperatures and conditions.

After the successful popping tests which were carried out in the wind tunnel, an industrial popping equipment was designed and drawn by an AutoCAD 2000 software (Fig. 2.).

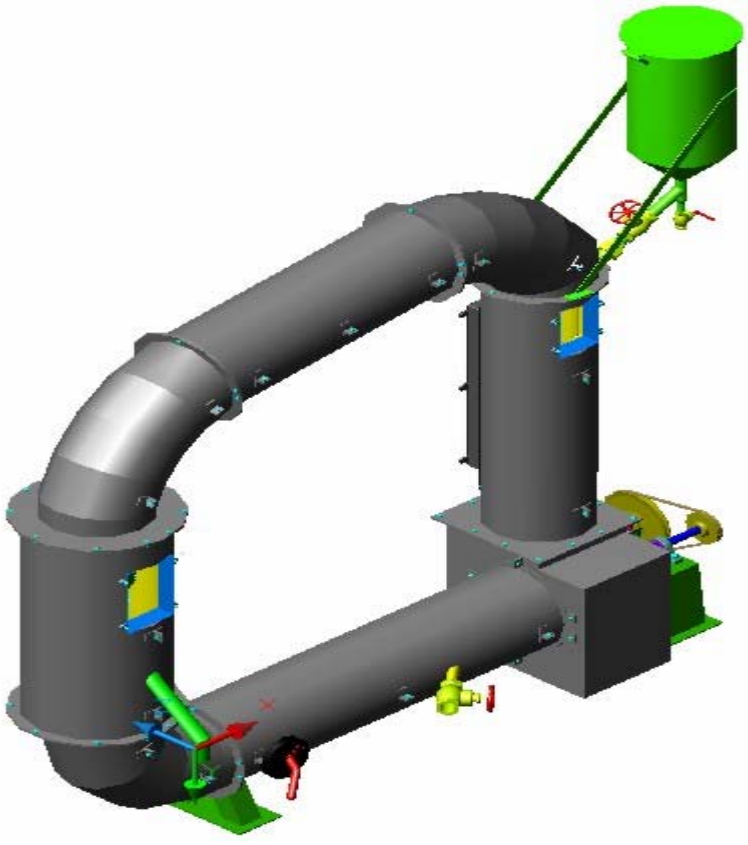

Fig. 2. The design of the popping equipment.

The equipment was made. The small seeds popping machine is made up by the following parts: pipe system, heating system, air delivery equipment, popping area, seed tank, seed separation equipment, temperature control electronics, pipe end with the seed collector.

Fig. 3. The new popping equipment

The new popping equipment was tested. The same measurements, examinations were done which were carried out in the experimental wind tunnel as well.
So: air velocity, temperature, air humidity, seeds humidity, the mass and volume of the seeds, the mass of the pooped seeds, the increase in volume, the duration of the popping process were measured.
The results were favourable. At last dry material (subtract) contents were compared.

Nutritional content and microbiological tests

After successful tests with popping, the raw amaranth seeds were examined in various ways and in authorized labs, to get informed about their nutritional content and the effect of heat treatment.
The experiments with amaranth seeds “Edith” demonstrated the American results, the high nutritional content, although it was concluded, that the raw grain is inclined to turn mouldy, therefore care must be taken when drying and storing.
The relative humidity content mustn’t exceed 17%.
Tests with popped amaranth demonstrate, that nutritional content compared to the raw reeds is not damaged after heat treatment.
Conclusions after microbiological tests:

- raw grain: to be stored in dry conditions,
- popped grain: a high humidity content may damage it.

Fibres content of amaranth grain, nutritional value are as follows:

- it has high nutritional content,
- it has high vitamin content,
- it is easily digested,
- it is easy to store and pack (microbiological tests) (Sikolya, 1998).

Photo acoustic method to test amaranth

Food quality control tests mean complex studying the physical and chemical parameters. Composition is one of the most significant of them. Chemicals is applied to control fat, protein, carbon hydrate, water content. These measures are sometimes very slow, impracticable, special chemicals are needed, and damage the samples. Nowadays-new methods came into the limelight, capable of replacing traditional analytical methods by their speed, exactness. Photo acoustic method is one of the competing modern methods. Using it, we gain good qualities and quantitative results from food products.
The photo acoustic spectroscopy method was successfully applied at comparative tests with amaranth seeds, flour, and popped amaranth.
Obviously, photo acoustic method is a good method to study food, raw materials. Let me mention examinations of milk protein, cereals flour, red pepper adulteration. (Dóka, 1996).
Raw and popped amaranth seeds and flour were examined by the photo acoustic method. The tests were conducted at the Pannon University of Agricultural sciences at the physics and mathematics department without any treatment of the samples in Mosonmagyaróvár.
Typical peaks of amaranth spectrum can't be observed, and obviously, the absorption is greater in the case of seeds due to the pigment of the shell.
For amaranth flour due to the amino acid absorption inside the seeds the signal increases near 235 (nm) and near280 (nm) due to ringed amino acids (Bhenyalamin, tyrosin, etc.).
For popped seeds the curve shows the same peculiarities as for the flour. Consequently, during popping absorption stripes typical of amino acids remain unchanged, that is, no transformation occurred. The seeds, flour and the popped amaranth contain the same amino acids.
It's impossible to determine absolute values using that method only show relative changes. The results are in the figure:

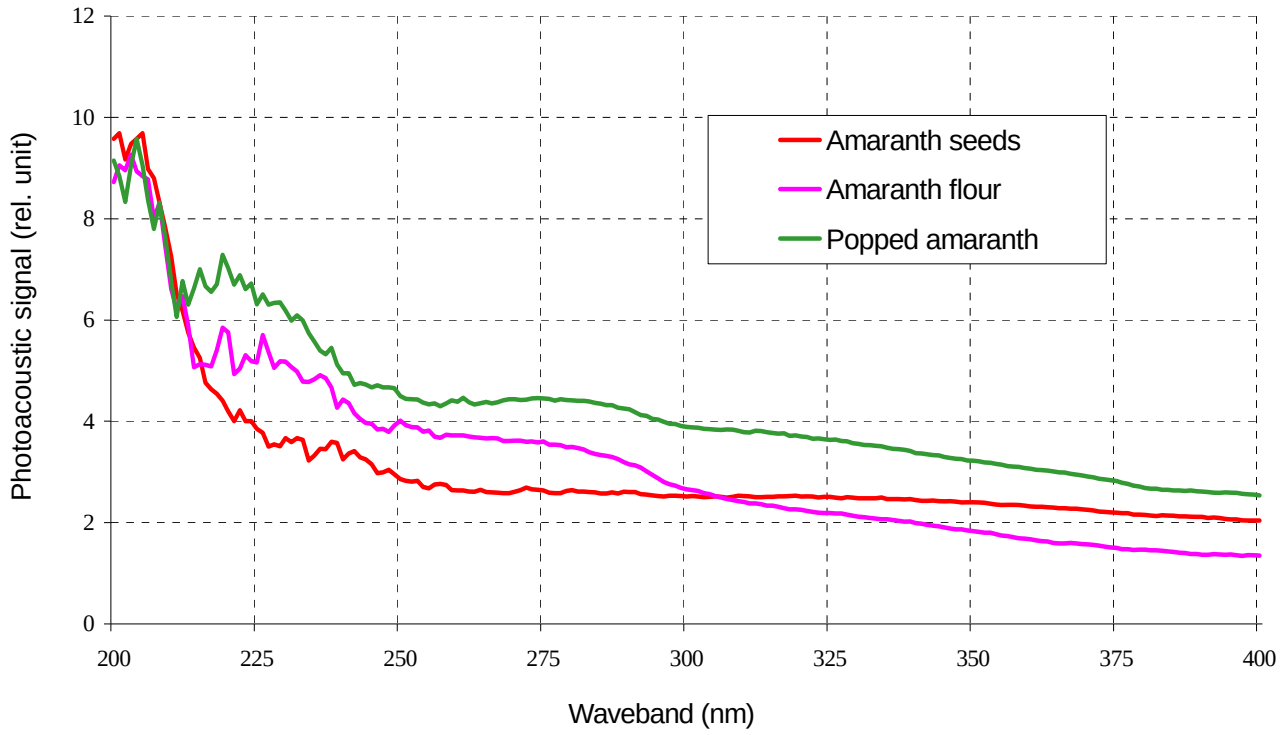

Fig.4. The amaranth grain, amaranth flour and popped amaranth comparative tests at 200-400 (nm) waveband

CONCLUSIONS AND RESULTS

Utilization of the scientific results in practice.
The scientific results are applied in various fields:

- manufacturing machinery for food industry,
    - milling industry,
    - baking industry,
    - canning industry,
    - confectioner's trade.
- Extension of the new popping method to other grains (popping rice and wheat)

Economic results
Research concerning amaranth has economic results:

- amaranth is used as seed grain and food of various types,
- owing to its high nutritional values applying this popping technology, amaranth meets the demands for reform food.

Amaranth is used in various branches of food industry as muesli in bakery products (bread, confectionery) in sweets (chocolate) in canning industry (as baby food, beverages) (Sikolya, 1994).

- Amaranth grain does not contain gluten therefore it can be used to prepare food for those, who suffer from flour allergy.
- This popping method can be used for various grains, for producing semi-prepared food. (We received on order for popping rice and wheat in experiments.)

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