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HEAT TREATMENT OF FOOD PRODUCTS IN
PACKETS OF POLYMER MATERIALS

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ABSTRACT:

Heat treatment of food products packed in packets made of materials like dacron-polyethylene (produced in USSR) and Khostafan-PE, Melineks-PE and Mailar-PE (imported from W. Germany, England and U.S.A. respectively) is investigated. Results of experiments on the preservation of food products in such packets are described.

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HEAT TREATMENT OF FOOD PRODUCTS IN PACKETS OF POLYMER MATERIALS

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Thermal Pasteurization and especial by sterilization of food products in polymer packings require their high heat resistance, strength, elasticity, steam and water impermeability, and chemical stability. These properties must be preserved when water or steam in conditions of high temperature (up to 120° C) act on the packing for 1-2 hrs.

In foreign and home food industry, film materials are used for packing. Only a layer of polyethylene provides moisture resistance and capability for thermal welding. The most well-known of these materials are Khostafan-PE (W. Germany), Melineks-PE (England), Mailar-PE (USA).

Technology of obtaining polyethyleneterephthalate-polyethylene, named as dacron-polyethylene (DP-1) has been developed in the Polymer Laboratory of Moscow Technological Institute of Meat and Milk Industry.

This material can be used for the packing of frozen cooked foods, which can be heated in boiling water, without defrosting. It can also be used for food products which are sterilized in packed form at temperatures of up to 120° C and for packing in hot state (80-90° C) or pasteurization at 100° C.

Sterilization at high temperatures is the most complex, because during this the polymer material is subjected to most severe conditions. Experiments on the sterilization of model media in packets made of film DP-1 showed that the weakness of this material is its insufficient adhesive strength, i.e. strengt between dacron base and polyethylene coating, which leads to the breaking of hermetic joints, and low heat resistance of the material, which violates the integrity of the polyethylene coating.

The combined material DP-1 was subjected to ultraviolet rays for 3-5 seconds to increase its adhesive strength. Such treatment not only increases the adhesive strength, but also increases the heat resistance of the material by about 10° C. Dacron-polyethylene DP-2 obtained by this technology can better withstand sterilization at 120° C.

The strength of welded joints is determined as follows. In one of the walls of the packet for packing a special sleeve is introduced and is hermetically sealed with the help of a washer and gaskets. The packet is hermetically welded from all sides and air is gradually injected into the packet through the sleeve. The minimum pressure at which a leak appears is noted from the manometer.

The basic properties of dacron-polyethylene DP-1 and DP-2 and imported films Khostafan-PE and Mailar-PE are given in table 1. (pag. 2)

It can be seen from the table that film DP-2 is considerably better in its resistance to sterilization and in adhesive strength than film DP-1. The film DP-2 is not inferior to the material Khostafan-PE in most of the properties; however, its permeability to vapor and water is slightly higher.

It has been established that for preserving the integrity of packing during thermal sterilization it is necessary that pressure in the autoclave should be higher than inside the packet. At 120° C it should be 19,62. 10⁴ N/M² (2 atm). Maximum danger of the loss of integrity arises in the beginning of cooling when temperature in the autoclave decreases much faster than in the packet. Therefore, it is necessary to maintain the counter pressure throughout the sterilization period, including the cooling of products to a temperature of 50-60° C.

Experiments on the sterilization of products in packets made of materials DP-1, DP-2, Khostafan-PE, Mailar-PE, were conducted in the All Soviet Research Institute of Canning and Vegetable-drying Industry. In packets "Cabbage cooked with oil" at 120° C was sterilized for 30 minutes, "Southern Salad" and "May Salad" at 105° C for 30 minutes. Products were preserved for 4 months. Results are represented in table 2.

Tomato juice "Chili stew", "Pickled chili", "Pumpkin thick soup" were canned in packets made of dacron-polyethylene in the Ukrainian Research Institute of Vegetable Growing and Potatoes. Sterilization was conducted in an autoclave at the following conditions: "Tomato-juice" at 100-110 C for 30-60 min, "Pumpkin thick soup" at 116° C for 20 min, all remaining products were sterilized at 100° C. After five months of storage no considerable difference was found in products preserved in packets made of the film and in glass jars.

TABLE 2

MATERIAL	"Southern Salad"	"May Salad"	"Cabbage cooked with oil"
	After sterilization	After storage for 4 months	After sterilization After storage for 4 months
DP-1	Noticeable bleaching of material weakening of adhesion of layers	Samples were removed from storage	Strong bleaching, melting of polyethylene layer, hermetic tightness is impaired.
DP-2	No change in material or product		Slight increase in dullness without impairment of joints, product remained unchanged.
Khostafan-PE	same		Noticeable increase in dullness, product remained unchanged.
Mailar-PE		No changes in material or product	Turbidity higher than in DP-2, product remained unchanged.

Material	Thickness of material (general and of individual layers), microns	Adhesive strength, gf/cm	Breaking point kgf/cm ²	Relative elongation, %	Permeability to steam during 24 hrs. g/O ₂ , m ²	Permeability to water during 24 hrs. g/O ₂ , m ²
Dacron-polyethylene DP-1	60-70(20+ +40-50)	150-200	500-600	100-150	0.05	0.05
Dacron-polyethylene DP-2	60-70(20+ +40-50)	Separation into layers was not possible	500-600	100-150	0.05	0.05
Khostafan-P E	60-65(12+ +48-50)	Separation into layers was not possible	400-500	100-150	0.03	0.03
Mailar-PE	45-50(12+ +30-35)	Separation into layers was not possible	500-600	70-100	0.02	

Strength of joints, N/m²

Result of sterilization in water
at 120° C for 1 hr.

Material	Before sterilization	After sterilization	Result of sterilization in water at 120° C for 1 hr.
DP-1	4,9. 10 ⁴ - 5,9. 10 ⁴ (0,5 - 0,6 atm) dacron comes off at joints	1,47.10 ⁴ - 1,96.10 ⁴ (0,15 - 0,20 atm) rupture along joints	Joints are hermetic tight, polyethylene coating has slightly melted. Material is slightly bleached.
DP-2	4,9. 10 ⁴ - 5,9. 10 ⁴ (0,5 - 0,6 atm) rupture along joints	(1,96.10 ⁴ (0,2 atm) rupture along joints	Joints are hermetic tight, separation of layers is not observed, melting is insignificant.
Khcstafan-PE	4,9.10 ⁴ - 5,9. 10 ⁴ (0,5 - 0,6 atm) rupture in film	1,47.10 ⁴ - 1,96.10 ⁴ (0,15 - 0,20 atm) rupture in film	Joints are hermetic tight, polyethylene coating has slightly melted, slight bleaching of material.
Mailar-PE	5,9.10 ⁴ - 6,9.10 ⁴ (0,6 - 0,7 atm) rupture in film	2,45.10 ⁴ - 2,94.10 ⁴ (0,25 - 0,30 atm) rupture in film	Joints are hermetic tight, bleaching and melting are not noticeable. Film did not undergo any change.