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STUDY OF THE POSSIBLE USE OF CONTOUR PACKINGS FOR VALIDOL TABLETS

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We have already studied certain polymer materials — high-pressure polyethylene, polypropylene, polystyrene [1]. As the result of our investigations, it was recommended that a thick-walled test tube made of polypropylene be used for packing validol tablets. This ensures the preservability of the preparation for a given service period at a storage temperature not higher than 20°C [2].

However, to satisfy the increasingly higher requirements with respect to the quality of the preparation and the packing, and increased operation efficiency, new, more perfect forms of packing are needed. At a present state of development, many specialists [3, 4] believe that such a form is a contour packing made of pellicular materials, which, from the technological point of view is economically expedient, hygienic and more convenient to use than the bulk packing containers.

The aim of the present work was to select a contour packing for validol tablets, made of pellicular materials. It was necessary to determine the stability of the polymer materials to the dissolving action of validol vapors, to compare their protective properties according to the penetrability factor and sorption coefficient.

For the investigation, we used model packings of the "packet" type, made of a varnish-covered cellophane, a double-layer polyethylene—cellophane film, polyvinyl chloride film, varnish-covered aluminum foil, and also the ready-for-use "Servak" type honeycomb packing made of polyvinyl chloride film and varnish-covered aluminum foil.

The thickness of each of these polymer materials was 35, 75, 250 and 25 μm, respectively. The thickness of the polyvinyl chloride film in the honeycomb packing was 120 μm.

The packings filled with tablets and the control packings without tablets were stored in thermostats: the packings made of cellophane and polyethylene—cellophane at 40, 60 ± 0.2°C, and those of polyvinyl chloride and aluminum foil at 20, 40, 50, 60 and 70 ± 0.2°C.

The stability of the polymer materials (varnish-covered cellophane and polyvinyl chloride) to the validol vapors was determined by IR spectroscopy, which is widely used for the analytical control of plastics [5, 6]. We also used the visual evaluation of the polymer materials and tablets.

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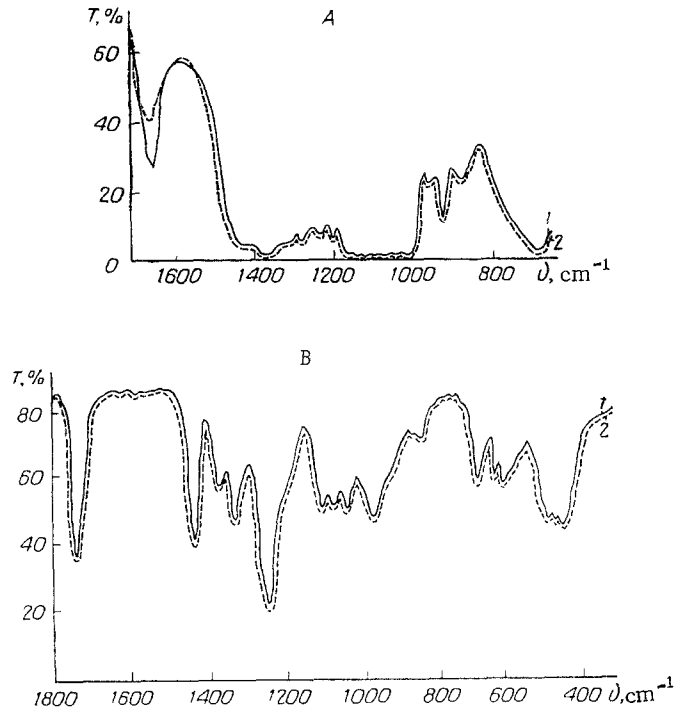

Fig. 1. IR Spectrum of varnish-covered cellophane (A) and polyvinyl chloride (B) before (1) and after (2) contact with validol tablets for 35 days at 50°C.

The penetrability factor and sorption coefficient were determined by the gravimetric method by known procedures [7].

EXPERIMENTAL

The IR spectra of the varnish-covered cellophane and polyvinyl chloride films were run on the UR-10 spectrophotometer (sodium chloride prism). To obtain a thickness of the polyvinyl chloride film convenient for measurements, we prepared a 3% solution of polyvinyl chloride in tetrahydrofuran. The solution was poured as a thin layer on glass, then placed in vacuum exciccator to remove the solvent. The thickness of the film thus obtained was 20 μm.

Figure 1 shows the spectra of films of a varnish-covered cellophane and polyvinyl chloride before and after contact with the validol tablets for 35 days at 50°C. In a comparison of the IR spectra of the films before and after contact with validol tablets, no appreciable differences were observed. The small change in the peak value of the varnish-covered cellophane (Fig. 1A, curve 2) at 1700 cm^{-1} is within the sensitivity limits of the determination. However, during visual inspection of packings made of varnish-covered cellophane, we observed a dehermetization of the weld seam of the packing, which can be explained by dissolution of the varnish in the validol vapors. On opening the packings made of polyethylene–cellophane film, partial stratification of the film was observed. As the result of its lipophilicity, validol penetrates through the polyethylene layer, but is strongly held by cellophane (hydrophilic polymer), so that a high concentration of the validol vapors is formed on the boundary between these two materials, which is the reason for the stratification of the film.

During the visual inspection of polyvinyl chloride packets with and without tablets stored at 60°C and above, we observed a warping of the film surface, grey coloration of the film and increase in brittleness. Under these temperatures, in honeycomb packings, the cells changed form, became grey in color, and increased in diameter from 27 mm (initially) to 29-30 mm (after storage), while the depth of the cell decreased correspondingly from 7 to 6.7 mm. At a temperature of 20, 40 and 50°C, the appearance of the polyvinyl chloride packings

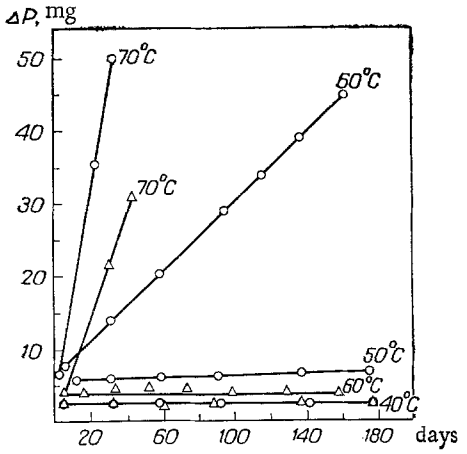

Fig. 2

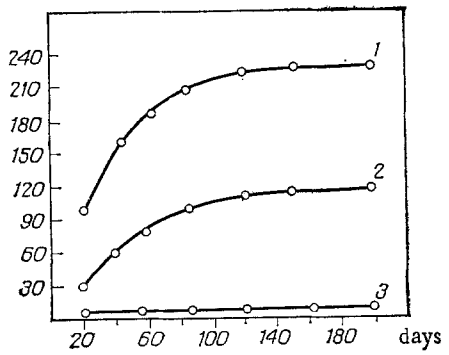

Fig. 3

Fig. 2. Kinetics of penetrability of validol vapors evolved from tablets through the type "Servak" packing and packets made of sheet polyvinyl chloride films. Circles — honeycomb packing, triangles — sheet film.

Fig. 3. Kinetics of sorption of validol vapors evolved from tablets by polyvinyl chloride. 1) 60°C, 2) 50°C, 3) 40°C. 1, 2) 70°C, 3, 5) 60°C, 4) 50°C, 6) 40°C. Circles — honeycomb packing, triangles — sheet film packing.*

did not change. Packings made of varnish-covered aluminum foil remained unchanged under all the experimental conditions.

Thus, of all the materials, the polyvinyl chloride film and the varnish-covered aluminum foil, whose protective properties were studied according to the penetrability factor and absorption coefficient, were found to be stable to validol vapors.

During the determination of the losses in weight of the validol vapors due to penetrability, it was found that decrease in the weight of the aluminum foil packings filled with validol tablets was equal to the decrease in weight of the control packings stored under similar conditions. The greatest decrease in weight of the packed tablets was 0.12%, which is within the limits of the experimental error, which in our experiment was 0.3%. Hence, the aluminum foil was found to be practically inpenetrable to the validol vapors.

The kinetics of penetrability of validol vapors through the packets made of sheet polyvinyl chloride film and the type "Servak" honeycomb packing are shown in Fig. 2. Figure 2 shows that there is practically no penetrability of the validol vapors through the packets made of the sheet polyvinyl chloride film at 20-60°C, and through the honeycomb packing at 20-50°C. A change in the weight of the above packings after 180 days of storage was less than 5 mg, which was within the experimental error.

A sharp increase in penetrability through the honeycomb packings was observed at 60 and 70°C, while penetrability through the packets made of sheet polyvinyl choloride film was observed only at 70°C.

Comparison of the penetrability factors (K, mg·mm/cm^2·24 h) showed that the penetrability factor of the validol vapors through the honeycomb packing at 60°C is 12.5 times higher than that through the sheet film at the same temperature.

Thus, according to the penetrability factor, the sheet polyvinyl chloride film is more thermostable than the film in the honeycomb packing. The increase in the penetrability of honeycomb packings can be explained by irreversible deformations to which thermoplastic materials are subjected during thermal molding. To take into account all the changes which a polymer material undergoes during the industrial treatment, we must determine the penetrability on finished products.

*As in Russian original — Publisher.

TABLE 1. Stability of Validol Tablets in Contour Packings (M ± m)

Packing	Initial quality index of tablets			Quality index of tablets after storage					
				12 months			18 months		
	quantitative content of validol, mg	mechanical strength, N/cm^2	disintegrability, sec	quantitative content of validol, mg	mechanical strength, N/cm^2	disintegrability, sec	quantitative content of validol, mg	mechanical strength, N/cm^2	disintegrability, sec
Type "Servak" honeycomb packing	60,2±1,6	66,53±9,47	288±22	58,9±2,4	69,00±12,34	303±2,4	57,8±2,4	73,25±5,75	301±16
Packet of varnish-covered aluminum foil	60,2±1,6	66,53±9,47	288±22	59,6±1,6	72,35±8,41	337±27	58,3±2,4	70,60±9,45	312±18

Note. Content of validol, in accordance with Pharmacopoeia article 42-1181-78, should be 0.066-0.054 g.

Figure 3 shows that the sorption of validol vapors by polyvinyl chloride is observed only on storage at a temperature higher than 40°C. At 40°C the value of absorption was inappreciable, and amounted to 9 mg after 12 months of storage. At 20°C no absorption of validol vapors by polyvinyl chloride was observed with our method.

The weight of the aluminum foil packings after contact with the validol vapors remained unchanged at 20°C for 12 months storage, which makes it possible to conclude that there is no sorption of validol vapors by the aluminum foil.

The sharp increase in the penetrability and sorption of the validol vapors by polyvinyl chloride at 60-70°C is apparently related to structural changes of polyvinyl chloride at a temperature close to the start of the softening point of the material (72-135°C). Hence, the use of articles made of polyvinyl chloride at a temperature higher than 40°C is not recommended.

At an operational temperature not higher than 40°C, the aluminum foil and polyvinyl chloride film have high protective properties according to the penetrability factor and sorption coefficient, and can be recommended for use in packings of validol tablets.

Aluminum foil is a promising material for the prepartion of non-honeycomb.contour packing for the validol tablets. A similar packing of polyvinyl chloride is unsuitable because of the high mechanical strength of the material, since the increased rigidity of the polyvinyl chloride film creates certain difficulties during the extraction of the tablets. The most promising and suitable for these purposes is a honeycomb packing made of polyvinyl chloride film and aluminum foil, in which high mechanical strength and transparence of polyvinyl chloride are combined with a lower but sufficient strength of aluminum foil.

The preservability of the validol tablets in the recommended packings was determined by storage at 20°C for a given period of service life (18 months). The quality of the tablets was found in accordance with the specifications and Pharmacopoeia article 42-1181-78. In the tablets, the quantitative content of validol, the mechanical strength and the disintegrability of the tablets were determined.

The results of the analysis of the preservability of the tablets are listed in Table 1.

Table 1 shows that the contour packings ensure a satisfactory preservability of the validol tablets for given service life.

Thus, we found that the honeycomb type "Servak" packing made of polyvinyl chloride film and varnish-covered aluminum foil and the non-honeycomb packing of varnish-covered aluminum foil are suitable for packing validol tablets. The validol vapors caused dissolution of the varnish on the cellophane and stratification of the combined polyethylene—cellophane film, and therefore these materials cannot be recommended for packing validol tablets.

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