Ilkogretim Online - Elementary Education Online, 2021; Vol 20 (Issue 6): pp. 305-309
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.06.033

STUDY OF ANTIMICROBIAL AND RHEOLOGICAL PROPERTIES OF CHITOSAN-BASED APIS MELLIFERA

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ABSTRACT- The article presents the results of a study of antimicrobial, fungicidal and rheological properties of mixed thickeners based on chitosan *Apis Mellifera* for active dyes used for printing fabrics.

Key words: thickener, chitosan, optical density, fungicide, viscosity, moisture.

I. INTRODUCTION

It is known that one of the urgent tasks is the protection of textile materials from biological damage by microorganisms and molds.
In the textile industry, starch and its derivatives are used for sizing, finishing and for printing fabrics as thickening agents. At the same time, starch is a rich medium for obtaining energy by many microorganisms through fermentation processes. Fermentation is the process of breaking down organic substances, mainly carbohydrates, under the influence of microorganisms or enzymes isolated from them, without the participation or with the participation of oxygen.
In this regard, in the textile industry, preservatives (antimicrobial agents) are often used, which are able to prevent the liquefaction of ready-made thickeners (prepared for future use for a few days). An alternative to the use of preservatives is the modification of starch thickeners or the addition of chitosan. In this case, it is expected that the shelf life of the prepared thickeners increases many times, which is economically beneficial, increases the environmental safety of technological processes, simplifies the technological process and leads to a decrease in energy costs.
The problem of biodeterioration is complex in scientific meaning and diversified in practice. Scientifically, it is based on knowledge of materials science, biology and chemistry.
Recently, the use of thickeners with biocidal properties has been considered as a promising method for biological protection of tissues from the effects of molds. The use of these thickeners allows for a combination of coloring and special finishing. The ingredients used in the finishing factories of the textile industry must have antibacterial properties, otherwise, after a day they are unusable [1].
One of the most important types of raw materials in the textile industry is various types of wool: sheep, camel, goat, rabbit, etc. Sheep wool is of the greatest industrial importance, the structure and properties of which have been studied in greater detail [2].
Currently, 135 strains of fungi capable of damaging cotton fibers belonging to various genera have been isolated. It was found that the number of phytopathogenic fungi is significantly lower than the number of cellulose decomposers: *Chaetomium globosum, Aspergillus flavus, Aspergillus niger, Rhizopus nigricans, Trichothecium roseum*. According to the author [3], these types significantly worsen the condition of raw cotton, in particular, sharply reduce the spinning properties of the fiber.
It was also revealed that the following types of fungi usually exist on cotton fibers: *Mucor* (uses water-soluble substances), *Aspergillus, Penicillium* (uses insoluble compounds), *Chaetomium, Trichoderma*, etc. (decomposes cellulose). This suggests that some types of molds cause true fiber degradation, from which simple superficial growth of microorganisms should be distinguished. For example, on the size of yarn, fabrics, *Mucor* fungi can actively vegetate, which are incapable of causing cellulose decomposition [4-5].

II. EXPERIMENTAL PART

Recently, the use of thickeners with biocidal properties has been considered as a promising method of tissue bioprotection from the effects of molds.
In this regard, we have studied the fungicidal properties of mixed thickeners for active dyes used in printing fabrics.
The most likely members of which cause damage are filamentous fungi [6-7].

In this regard, we used 6-ball wort containing Chapek-Dox elective environment, which is a rich substrate for filamentous fungi.
Chemical composition of the nutrient environment Chapek-Dox: glucose-30,0; $NaNO_3$-3,0; K_2HPO_4-1.0; $MgSO_4$ x $7H_2O$-0.5; KCl-0.5; $FeSO_4$ x $7H_2O$-0.01; agar-agar-25; distilled water-pH 6-6,5.
The environment was sterilized at 1.0 ATM.
For cultivation, a cellulolytic active strain of pure cultures of the fungus Aspergillus terreus was used, obtained from the culture collections of the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan.
The environment with inoculated samples the thickener was incubated in a thermostat 28 ^oC for 5 days.
Determination of the fungicidal activity was carried out in vitro.
Freshly prepared thickeners were introduced into the medium under aseptic conditions in an amount of 1:2.
Optical density was measured in a spectrophotometer at 550 nm.
As a result of observations, it was revealed that these new thickeners on the basis of exhibit pronounced antimicrobial activity in relation to the micelle fungus Aspergillus terreus.
The optical density of the samples shows that these thickeners are resistant to filamentous fungi.
Thickener 1: Uzkhitan (chitosan) - CMS - HAE, Thickener 2: Uzkhitan (chitosan) - CMS, Thickener 3: Uzkhitan (chitosan) - HAE

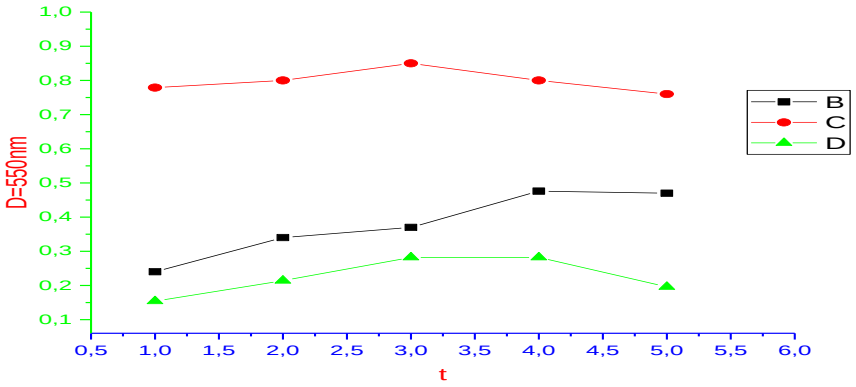

Fig. 1. Dependence of the optical density of the thickener per day

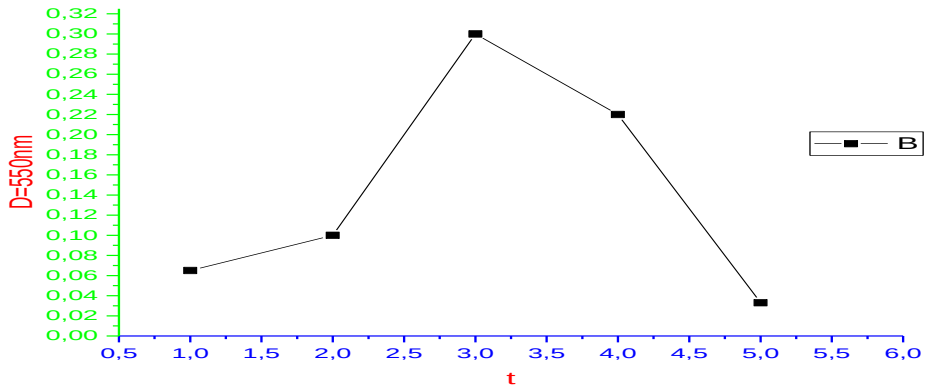

Fig. 2. The dependence of the optical density the control the Chapek-Dox environment in day

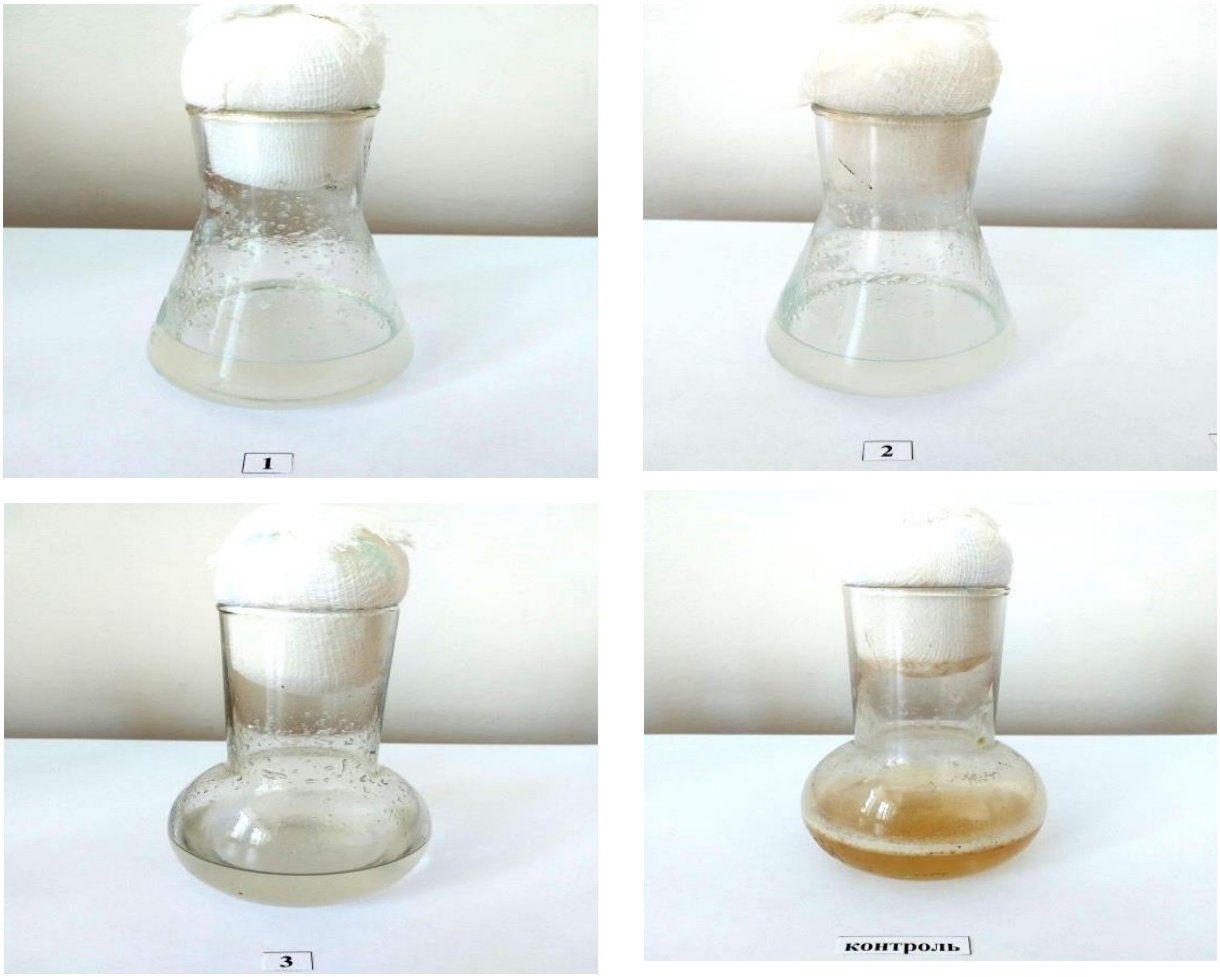

Fig. 3. Photo of thickeners and Chapek-Dox environment, cultivation of *Aspergillus terreus* after 5 days

Figure 1 shows that the optical density of the thickening is little changed by the influence of the fungus *Aspergillus terreus*. This indicates that the constituent parts of the developed thickener are not a good substrate for microorganisms.

As can be seen from Figure 2, during the cultivation of the fungus *Aspergillus terreus*, the composition of the nutrient medium changed dramatically.

The photographs show that on the 3rd day of cultivation, on the surface of the thickener 4 of the Chapek-Dox environment, the formation of a massive film was observed, which is a characteristic sign of the growth of microorganisms. At the same time, thickener-1: Uzkhitan (chitosan) - CMS - HAE, thickener-2: Uzkhitan (chitosan) - CMS, thickener-3: Uzkhitan (chitosan) - HAE remained almost transparent, which is also shown in Figure 3.

The main rheological properties of concentrated aqueous solutions of thickeners and printing inks are viscosity, elasticity and viscosity. These properties are studied by rheology - the science of fluidity of substances, which considers the processes associated with irreversible, permanent deformations. The measurement of the viscosity of chitosan solutions was carried out in an Ubbelode viscometer with a capillary diameter of 0.5 mm and using 0.2 M acetic acid solutions and 0.1 M sodium acetate solution in a ratio of 1: 1 by volume as a solvent (solvent expiration time 22 sec) at temperature 30^0C. The method is based on measuring the outflow time of a polymer solution with a consistently decreasing concentration in the solution [8-12]. The values of the specific (η_{sp}) and reduced (η_{rd}) viscosity of chitosan were calculated, the intrinsic viscosity [η] was found as the intersection point of the straight line $\eta_{rd} = \eta_{rd}$ extrapolated to zero concentration of chitosan.

The moisture content of the samples was determined using a METTLERTOLEDOLP16 installation according to the instructions for using the device. The method is based on drying the sample by heating to constant weight.

The mass fraction of ash was determined by burning the sample and weighing the residue [13-14].

The calculation of the results and values are presented in table 1.

Table 1.

Name	Appearance	Moisture, %	Viscosity, Pa*c 10^{-3}	Total nitrogen content, %	Molecular mass, kDa
chitosan	beige	10,3	3,28	8,31	162

III. RESULTS

A thickening composition of water-soluble polymer compositions with desired properties has been developed based on a synergistic polymer system consisting of carboxymethylstarch and chitosan, a hydrolyzed acrylic emulsion and instead of expensive ingredients.

The behavior of both an individual polymer and their mixtures of various compositions has been systematically studied. The rheological behavior of natural polymers and their mixtures with uzkhitan (chitosan) shows that these systems are non-Newtonian pseudo-plastic fluids with a noticeable viscous flow anomaly, which is determined by the structural polymer network, which breaks down with increasing shear stress.

Revealed bactericidal properties of mixed thickeners based on carboxymethylated starch and water-soluble polyacrylates. They exhibit a pronounced antimicrobial activity against various types of microorganisms that cause damage to the thickener. This mixed thickener is stable and can be used even on the second day for printing cotton fabrics with active dye.

IV. CONCLUSION

From the results of the study of the antimicrobial and rheological properties of thickeners based on chitosan *Apis Mellifera*, it can be concluded that chitosan has valuable properties that can improve the anticoloristic characteristics of finished textile materials, and makes it a promising textile auxiliary substance, unjustifiably little used in the textile industry. Due to its biological activity, chitosan imparts fungicidal and bacteriostatic properties to textile materials, and increases the durability of products. The new mixed thickener is highly resistant to bacteria and exhibits fungicidal properties. Among thickeners, thickeners based on Uzhitan (chitosan) – CMS - HAE, Uzkhitan (chitosan) - CMS have the most pronounced bactericidal activity, and these thickeners are more stable, they can be used the next day and even for 2 days for printing mixed fabrics.

Thanks

The authors express their gratitude to the head of the Department of General Chemistry of the Tashkent State Technical University, Doctor of Chemical Sciences, Professor Gulnora Ikhtiyarova, as well as the staff of the Institute of Microbiology of the Academy of Sciences of the Republic of Uzbekistan for the practical assistance provided in the implementation of this work.

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