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Cotton-made cellulose support for anti-allergic pajamas

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ABSTRACT

The cotton used to produce an interlock knitted fabric is alkaline boiled, bleached and after drying, it is grafted with monochlorotriazinyl-beta-cyclodextrin (MCT-β-CD) as a support of an inclusion compound (IC) with natural anti-allergic active principles, in order to improve the curative properties and the comfort. Are used: extract of *Viola tricolor Herb* (VtH), solution of *propolis* (P) and of *menthol* (M), as well as the pharmacologic products: advantan (AD), hydrocortisone (HYD) and pimechrolimus (PI). The dimensions of the active compound molecules were established with software. The textile material grafted with MCT-β-CD and with active principles absorbed in the cyclodextrin cavity is investigated by EDX. The anti-microbial activity of VtH, P and M was tested. Tactile determinations of softness were performed with human appraisers. By assembling the anti-allergic knitted fabric with untreated fabric, therapeutic pajamas were obtained. The manner to process and manufacture the pajamas for patients with contact and atopic (DA) dermatitis (DC) is presented.

1. Introduction

More than 500 million people suffer from different forms of allergies. Allergy is considered an exaggerated immune response of the body to a foreign substance named allergen. Recent researches suggest a continuous rise of different forms of allergies as a consequence of the standard of living due to rapid industrial civilization. Allergy is the excessive and anarchic response of the immune system to the action of an intruder known as allergen, which for most people is harmless (Aalberse & Crameri, 2011; Moldovan, 2000).

Allergic diseases are caused by various environmental factors (Moldovan, 2000; Popescu, 1998). Susceptible individuals are allergic, and are called atopic. In order to become active, the allergen requires overcoming a threshold limit (Aalberse, 2011) and this for a period necessary to initiate an immune response. The presence of an allergen is often stimulated by microbial flora (Rippke, 2004). Available evidence suggests that viral respiratory infection can initiate, maintain and activate exacerbation of allergic conditions in respiratory tract. Allergies are characterized by an innate or adaptive immunity malfunction, with specific symptomatology for the skin (dermatitis), for nasal mucosa (rhinitis), for respiratory tract (asthma) or even high – risk lethal symptoms such as anaphylactic shock (Petrescu, Branisteanu, & Statescu, 2008).

The works presents the stages of producing the textile support with anti-allergic properties, which are used for pajamas manufacturing. The medical information is only used to the extent that it helps understanding the aspects which determine the textile material processing. The stages in realization of the anti-allergic clothing are adapted to the symptoms of DC and DA affected patients. The specialized literature (Aalberse & Crameri, 2011) specifies that, in order to efficiently cure the coetaneous allergic manifestations, it is necessary to apply specific medication, correlated with the utilization of pajamas that provides a coetaneous special comfort at the contact between the sick skin and the clothes.

The allergy prophylaxis is difficult. The discomfort and frustration of patients with allergic dermatitis, lethal cases and the costs of medical assistance represents a problem that motivates it. When the allergen has not been identified, avoiding it from patient proximity is not possible and the measures and medical treatment attenuate the disease symptoms, but cannot solve the malady.

Fig. 1 presents the location where the anti-allergic textile material acts to prevent or to stop the allergy evolution. Thus, at the allergen entrance, by means of lymphocytes T helper (white cells playing the role in phagocytosis), an IgE is formed as an element of cellular memory, which later on is fixed on the mastocite membrane.

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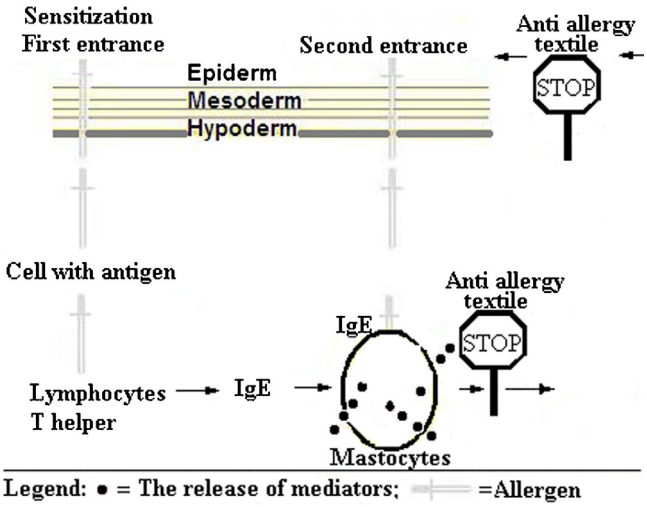

Fig. 1.

Under this situation, the body is sensitized about the presence of an allergen by the formation of antibodies which remember the intruder characteristics. Sensitization is the state of an organism which reacts in a manner different from a normal one. After the second entrance, the allergen is recognized by the specific IgE (Moldovan, 2000; Petrescu et al., 2008) and, together with it, are fixed on the mastocyte membrane, triggering the release of mediators (histamine, cytokines, substances released by nervous fibres that transmit a nervous inflow). The release of mediators initiates the allergic episode as an energetic, uncontrolled and unpredictable reaction. In order to stop the anarchic manifestations, emergency pharmaceutical products are used, such as Theophylline, as well as immune-suppressing products (such as hydrocortisone or newer generations) or active principles from natural products that contain flavonoides (VtH and P). The interaction of flavonoides with chemical mediators is not known in literature. The anti-allergic textile support is a barrier that stops the second entrance (Fig. 1) of allergen through skin or blocks the mediator release from mastocytes by the therapeutic action of the active principle provided by the textile interface.

2. Experimental

2.1. Materials and methods

In our researches one used as a textile support an all-cotton interlock knitted fabric from yarns with fineness Nm = 60/l. The usual reactives for cotton articles preparations are: NaOH, Na_2CO_3, $Na_2S_2O_3$, H_2O_2 and Na_2SiO_3 in commercial form, without additional purification treatments, as well as an anionic surfactant Lavotan (Bezema) and MCT-β-CD (Wacker Chemie).

For the application on the textile support, we have used the alcoholic extract (25%) of VtH (a plant from spontaneous flora of Romania); P – from bees families of Danesti (Vaslui county) collected with a special spoon from the wooden part of the beehive (in 2010); the obtained P is conditioned, weighted and solved in ethanol (98%) at 40 °C and filtered on filter paper. The filtrate is concentrated through evaporation, after which it is solved again in ethanol as a 30% (w/v) solution. – M is found in *Mentha piperita*, but its extraction from plants is performed with a low yield. The synthetic product is used instead, as 30% solution of tablets (Sigma Aldrich) in ethanol.

In order to determine the molecule dimensions of the active compounds from VtH and P, as well as from M, AD and PI, the MarvinSpace ChemAxon 5.4.0.0 software was used.

Studies on toxicity were carried out on VtH and M on mices and Guinea pigs purchased from the "Cantacuzino" Institute of Bucharest. The performed procedure and experiments are practiced in pharmacology to establish the mean lethal dose of a product, denoted by DL_{50} according to OECD 425 standards, and afterwards to establish the therapeutic dose.

The determinations of elemental analysis used EDAX Genesis 2005 equipment (FEI Company from Holland).

For softness determinations, three groups of appraisers were used. The first group from the Faculty of Textiles from Iassy, coded as **TPMI**, consists of 50 persons: teaching personnel, students from the Department of Chemical Finish, and auxiliary personnel with ages between 20 and 29 years, 30 and 39 years, and 50 and 65 years. The second group, coded as **ANR**, consisted of 10 sightless persons from the Association of Sightless Persons, Iasi, aged between 33 and 75 years. The third group consisted of 16 persons from the "Moldova" Theoretical High school for Persons with sight deficiencies of Targu Frumos, coded as **LDV**. The **LDV** group consisted of sightless teaching staff and pupils aged between 13 and 29 and 30 and 35 years, with tactile well-trained through Braille alphabet reading. A questionnaire was filled up for each person, in which three standard softness samples and five knitted fabric samples were used, coded from (1) to (5). The standard sample I is a rough woven fabric (specific weight 110 g/m^2) of mono-filamentary polyester with yarn count Nm-50/1 impregnated with an acrylic resin with softness of 2% (arbitrarily attached). The standard sample II is a wool-type woven fabric(specific weight of 346 g/m^2) with the content of 55% polyester + 45% wool from "Dorobantu" Company of Ploiesti, for which the softness was arbitrarily considered as 50%. The standard sample III, an all-cotton flock knitting for stockings destined for children, whose softness was considered equal to 90%.

For determining the resistance to microbiological deterioration of cotton materials treated with natural active compounds, we prepared an allergic medium by introducing the material samples in soil suspensions media. Soil was sampled at 10–15 cm depth from greenhouse of University of Agricultural Sciences and Veterinary Medicine Iasi. Supplementary, the resistance to microbial attack was tested using microbiological media plates filled with soil according to blotter method. To determine the microorganisms capable to deteriorate the cotton materials, all plates were incubated at 28 °C in a thermostat (Memmert, Germany) for 28 days. Starting from the fifth day, microscopic analyses regarding total microbiota were performed. Isolated microorganisms were used to inoculate plate with nutritive media.

Potato dextrose agar (PDA) in different compositions (classic, with streptomycin and rose-bengal stain) and Czapek Dox were the media used in this research. Streptomycin antibiotic was used to control the reproduction of bacteria and rose-bengal stain was used to limit the growth of fast-growing moulds (e.g. *Rhizopus* spp., *Trichoderma* spp.). spp = genera. Czapek-Dox agar media was used for filamentous fungi identification. Microbiological media plates were prepared using Masterclave 09 plate maker and an aliquot portion of 15 mL of media was poured using APS 320 automated Petri plate filler (AES Laboratoire, France).

After inoculation, the plates were brought subsequently to the laboratory for incubation. The Petri plates used for fungal sampling were incubated for 5–7 days at room temperature (28 °C). After incubation, fungal species were analysed with a light microscopy (1000× magnification) and identified to genus and species level based on morphological and physiological characteristics following the works provided by (Barnett & Hunter, 1999; De Hoog, Guarro, Gené, & Figueras, 2000; Ellis and Ellis, 1997; Ellis, 1971).