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ANTIMICROBIAL FINISHING ACTION OF CAMPHORA FOR COTTON AND POLYESTER FABRICS

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Abstract: This research work deals with a finishing agent using Camphora and assessing its antimicrobial properties on cotton and polyester fabrics. The Camphora was obtained from the open market in Owerri, Imo State, Nigeria and crushed in small particles (billionths parts or 10^{-9} parts of it). The Camphora was used to make formulations with water of various concentrations of 14.3g/0.5dm^3, 28.6g/0.5dm^3 and 42.9g/0.5dm^3. These various concentrations were used to culture the two fabric samples- 100% cotton and 100% polyester. At concentration below 42.9g/0.5dm^3 both fabrics indicated growth of bacteria while at concentration of 42.9g/0.5dm^3 no growth of bacteria was indicated. This implies that at this concentration (42.9g/0.5dm^3), Camphora can be used conveniently as it inhibits the growth of bacteria on both fabrics. Biochemical test carried out on the cultured fabrics indicated the presence of Escherichia coli (E-coli)- an aerobic bacterium, while those without growth of bacteria do not indicate the presence of Escherichia coli (E-coli). The use of Camphora as antimicrobial finishing agent does not only give better resistance to bacteria growth, it also prevents the problems of unpleasant odour, retaining the weight, look, feel, colour and breath ability of the fabric.

KEYWORDS: Camphora, Antimicrobial, Culture, Biochemical test, Cotton and polyester.

I. INTRODUCTION

This technology deals with molecular and atomic particles that are measured in molecular sizes (billionths of a meter or 10^{-9} meters). When converted to such a level a material may take a new property and functions or increase in its ability to reach and penetrate different areas. Not only does the molecular size allow ions to easily penetrate cells of microorganisms, but the positive charge increases surface area and even draws the negatively charged elements towards them, thus increasing their ability to affect more molecules.

Nano-composites provide a high porosity where the high surface area and nature of the active nano material selected will absorb and decompose chemical and biological agents into harmless products (Kathiervelu, 2003).

Silpure is an antibacterial finish that has been specially developed for textile application for linen, sheets and pillow cases, clothing, socks and underwear. Silpure is also suitable as a protection finish for mattress fabrics. It is an application in which real silver is processed by micro-encapsulation in the fibre, resulting in an outstanding general antibacterial effect. This finish is permanent and resistant, even when the fabric is washed so many times. It can also be described as a natural finish, and hence one which is ecologically acceptable. Silver has proved of value in conventional medicine, and the independent scientific test conducted when developing silpure-across a broad spectrum of bacteria but in particular to check on the efficiency of its protection against the hospital bug has exclusive positive results. As an antibacterial protection, silpure is therefore a proper, significantly cheaper alternative to

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comparable finishes with the same properties (Bjelkhagen, 1995). Aesthetic side-effects are also completely prevented with an antibacterial treatment such as silpure. (Qian and Hinestroza, 2004).

Finishes to prevent moth damage operate according to one of two basic principles. Either the finish is a substance (an insecticide) that is poisonous to the moth larvae, or the finish alters the fibre in some way that makes the wool unpalatable to moth larvae, thereby "starving" the grubs. The insecticide finish may be applied during manufacture or during dry cleaning.

The second type of finish effects a change in the chemical structure of the fibre. Through chemical treatment, the disulphide cross-linkages which are attacked by the moth larvae, are changed and are replaced by longer linkages that the moth cannot digest (Averell, 2001).

The laundering of articles involves washing them so that they look new again. Stains have to be removed and articles may be stiffened if necessary. Finishing by ironing or pressing gives the articles a smooth appearance and helps them to stay clean longer (Anyakoha, 1999).

Camphor is the granular crystal produced through the refinement of the branch, trunk, leaf and root of a plant Cinnamomum camphora (L.) J. Presl., of the family Lauraceae. The plant is common in China, Taiwan, and Japan. It is a attractive tree 30m in height.

Camphor is isolated by passing steam through the pulverized wood and condensing the vapour. Camphor crystallizes from the oily portion of the distillate and is purified by pressing and sublimation. Since the early 1930s camphor has been made by several processes from the compound a-pinene.

Camphor is an organic compound of penetrating, somewhat musty aroma, used for many centuries as a component of incense and as medicine (Xiang, 2006). Modern uses of camphor have been as a plasticizer for cellulose nitrate and as an insect repellent, particularly for moths. The molecular formula is $C_{10}H_{16}O$. The pure compound is a white, waxy solid that melts at about 78-79^0C.

In china, the tree Cinnamomum camphora is mainly produced in the places to the south of the Yangtze River and in the Southwest parts, among which Taiwan gives the greatest yield, and camphor produced there is of good quality.

Picked and collected all the year round, old trees of Cinnamomum camphora are mostly felled from September to December. Saw and chop the tree into pieces, distill them in the distiller, cool and obtain refined camphor. Refined camphor can also be obtained from unrefined camphor through sublimation and refinement. Since it is quite volatile, camphor should be packed and sealed for storage.

II. MATERIALS AND METHODS

2.1 MATERIALS

(a) Camphora: The camphora used in this study was bought from the open market in Owerri, Nigeria It is white in colour with a net weight of 14.3g. It was obtained in a wrap of eight soft tablets, and can be broken into nano particles.

(b) Vinegar: This material was obtained from the commercial stores, also in Owerri. Made in England by H.J Heinz Co. ltd., the content is 568 milliliter per bottle.

(c) Water: Water was obtained from storage tank in the Polymer Department laboratory, Federal University of Technology, Owerri, Nigeria.

(d) Fabric Samples:

(i) 100% cotton

Colour: creamy white, and 2.6g in weight

(ii) 10% polyester.

Colour: creamy white, 2.8g in weight

(e) EQUIPMENTS

(i) Electronic weighing balance (ii) Aluminum foil (iii) Scissors (v) 500ml volumetric flask

(vi) 100ml measuring cylinder (vii) Sterilizer (portable steam sterilizer 7500 series) (viii) Stove (ix) Slide (x) 100 x objective microscope (xi) Wire loop (xii) Incubator (xiii) Spatula

(f) CHEMICALS

(i) Nutrient Agar (ii) Crystal Violet (iii) Lugol's lodine (iv) Safranine (v) Immersion oil (vi) Indole reagent.

2.2 METHODS

2.2.1 PREPARATION OF NUTRIENT AGAR

The standard measurement for the preparation of nutrient agar is 28g of the Agar in 1 litre of water. In the course of this study, 14g nutrient agar was used in 500 milliliter of water.

A white paper was placed on the electronic weighing balance. The weight was found to be 0.9g. Using the spatula the nutrient agar was collected and poured on the paper. A mass of 14.9g was realized to account for the 0.9g mass of the paper. The whole content was emptied in 500 millileter volumetric flask and shaken

thoroughly. The content was placed in the sterilizer for 15 seconds at a boiling temperature ($100^{O}C$). It was poured into 6 petri dishes, labeled accordingly for easy identification. It was left for 24 hours to solidify in a refrigerator.

2.2.2 APPEARANCES OF BACTERIAL COLONIES ON SOLID MEDIA

Bacterial colonies should be examined in good light. When viewed from above colonies may appear round, irregular, crenated or branching. They may be transparent or opaque and their surfaces may be smooth or rough, dull or shiny. The colonies of capsulated species appear mucous.

When viewed from side, colonies may appear flat or raised in varying degrees sometimes with beveled edges or with a central elevation or depression.

When touched with a wire loop, colonies are soft and easily emulsified. Others are difficult to break up.

The colour of colonies also helps to identify bacteria, especially when using differential media containing indicators.

2.2.3 CULTURE OF FABRIC SAMPLES

The samples of the two fabrics (100% cotton and 100% polyester) were cut into particles using scissors and different formulations were made from them. Masses of 14.3g, 28.6g, and 42.9g of the camphora were weighed, crushed into tiny particles and each was dissolved in 500 milliliter of water. The content was emptied into 6 sterilized disposable petri dishes, each concentration poured into two separate petri dishes.10 millileter of Vinegar was also measured out into 8 sterilized disposable petri dishes. The first and second petri dishes was left undiluted, the third and fourth diluted with 1ml water. Fifth and sixth plate diluted with 4ml water while seventh and eighth plate was diluted with 5ml water respectively. The fabric sample was placed in each. Table 2.1 shows the labeling and concentration of the various plates.

Plates	Fabric Samples	Content/concentrations
A	Cotton	14.3g camphora in 500ml H_20
B	Polyester	14.3g camphora in 500ml H_20
C	Cotton	28.6g camphora in 500ml H_20
D	Polyester	28.6g camphora in 500mI H_20
E	Cotton	42.9g camphora in 500mil H_20
F	Polyester	42.9g camphora in 500ml H_20
G	Cotton	10ml vinegar in 1ml H_20
H	Polyester	10ml vinegar in 1ml H_20
I	Cotton	10ml vinegar in 4ml H_20
J	Polyester	10ml vinegar in 4ml H_20
K	Cotton	10ml vinegar in 5ml H_20
L	Polyester	10ml vinegar in 5ml H_20
M	Cotton	10ml vinegar without H_20
N	Polyester	10ml vinegar without H_20

Table 2.1: Labeling and concentration of the various plates

Samples in the various plates, left for 24 hours were collected using a sterilized wire loop and smeared on the nutrient agar bearing similar labeling. After each use, the wire loop was sterilized in a Bunsen burner (flame) to avoid contamination. The dishes (plates) and their contents were then incubated at a temperature of $35^{O}C$ to $37^{O}C$ for 24hours to check for growth of any microorganism. After 24hours, some samples indicated scanty growth, some heavy growth and others no growth. As they were viewed from above, the media remain transparent, no colour change was observed.

Samples that indicated no growth of pathogens were re-incubated for another 24hours which is the maximum incubation periods at which growth is expected. Those that have heavy growth were not re-incubated.

2.2.4 Gram Staining

The Gram staining reaction is used to help indentify pathogens in specimens and cultures by their Gram reaction (Gram Positive and Gram Negative) and

morphology. Materials Required: (i) Crystal Violet (ii) Lugol's Iodine (iii) Safranine

Principle:

A sample was collected with a sterilized wire loop from the different samples that indicated growth (cultured media) and smeared on the slides.

(ii) The slides were allowed to dry.

(iii) The slides were flooded with crystal violet, allowed to stay for 30 seconds, and then rinsed with water.

(iv) Lugol's iodine was flooded on the slides, allowed to stay for another 30 seconds, and then rinsed with water.

(v) Safranine was used in similar manner and rinsed after 5 seconds. They were allowed to dry.

(vi) Oil immersion was dropped on the slide – this aids visibility and clarity of any pathogen.

(vii) The slides were examined using a microscope in a good light by a 100 x objective.

NOTE: The smear on the slides were stained "Red" thus indicating "Gram Negative Bacteria".

2.2.5. INDOLE TEST:

Testing for an indole production is important in the identification of bacteria. Most strains of E. coli

III RESULTS AND DISCUSSION

3.1 Results

(Escherichia coli) species break down the amino acid tryptophan with the release of indole.

The test organisms from different samples that had growth were cultured in a medium which contains tryptophan. Indole production is detected by indole reagent which contains 4 (p)- dimethylamino benzaldehyde. This reacted with the indole to produce a red coloured compound. The red coloured compound indicated the presence of E-coli in the various samples that had growth.

Plates	Fabric Samples	Content/concentrations	Growth status after 24hours	Growth status after 48hours
A	Cotton	14.3g camphora in 500ml H_20	Heavy growth	No growth
B	Polyester	14.3g camphora in 500ml H_20	Scanty growth	Heavy growth
C	Cotton	28.6g camphora in 500ml H_20	Scanty growth	Heavy growth
D	Polyester	28.6g camphora in 500mI H_20	Scanty growth	Scanty growth
E	Cotton	42.9g camphora in 500mil H_20	No growth	No growth
F	Polyester	42.9g camphora in 500ml H_20	No growth	No growth
G	Cotton	10ml vinegar in 1ml H_20	Heavy growth	No growth
H	Polyester	10ml vinegar in 1ml H_20	Scanty growth	Scanty growth
I	Cotton	10ml vinegar in 4ml H_20	Heavy growth	No growth
J	Polyester	10ml vinegar in 4ml H_20	Scanty growth	Scanty growth
K	Cotton	10ml vinegar in 5ml H_20	Heavy growth	No growth
L	Polyester	10ml vinegar in 5ml H_20	Scanty growth	Heavy growth
M	Cotton	10ml vinegar without H_20	Scanty growth	No growth
N	Polyester	10ml vinegar without H_20	No growth	No growth

Table 3.1 Result of the incubation of samples

3.2 DISCUSSION

The fabric samples (100% Cotton and 100% Polyester) show that, at the concentration of Nano-Camphora at 14.3g/0.5dm^3, there was heavy growth of bacteria on the cotton fabric while the polyester fabric indicated scanty growth. This implies that Nano-Camphora, at that concentration gives better protection against microbial activity on polyester than cotton. As the concentration increases to 28.6g/0.5dm^3 both fabric samples show scanty growth of bacteria. At concentration of 42.9g/0.5dm^3, no growth was indicated on both fabric samples. This implies that at this concentration, NanoCamphora can be used conveniently as it inhibits the growth of bacteria on both fabrics.

Increasing the concentration by using more of Camphora could imply wastage of resources as no

bacteria growth will occur at concentrations greater than 42.9g/0.5dm^3.

Outstanding result was also obtained in the use of Vinegar, both fabrics indicated no growth when used undiluted. On diluting 10ml of Vinegar with 1 ml of water, 4ml of water and 5ml of water respectively cotton fabric show considerable growth. While at these various concentration polyester had a better protection against microbial growth than cotton. Best result is obtained for both cotton and polyester when vinegar is used undiluted.

3.2.1 EFFECT OF NANO CAMPHORA ON FINISHED FABRIC

Cotton and polyester fabrics are the most difficult fabrics to treat for antimicrobial protection. Nano Camphora does not only give a better resistance to microbial growth, it also solves the problems of unpleasant odor. Hence camphora-treated garments carry a promise of lasting cleanliness and freshness. As such, it can be used as a final rinse for babies wear such as napkins, bedspreads, cushions, pillow coverings, inner wears of ladies and men where cleanliness is of high demand. Nano-camphora also finds application in washing bandages in tropical burn therapy to prevent wound infection.

3.2.2 CONTRIBUTION TO KNOWLEDGE

(1) At a concentration of 42.9g/0.5dm^3,it was found that nano-camphora is a useful antimicrobial finishing agent on cotton and polyester fabrics. When it is used in the last rinse of a washing process, it gives the fabrics a better handle and renders it bacteria-free. Its anti-bactericidal nature makes it useful as a household cleansing agent; especially in areas that are highly susceptible to bacterial infection.

(2) Perfumes and other deodorants are exorbitant for the poor masses to obtain. Nano-camhora formulation solves this problem as it gives better fragrance to wearing apparel, and is easily affordable hence it can be used to replace the exorbitant ones of similar usage.

(3) The good fragrance of nano-camphora formulation solves the problems of unpleasant odour on wearing apparel.

IV. CONCLUSION

From the observation and discussion, it is found that both cotton and polyester fabrics when treated with Nano Camphora at a concentration of 42.9g/0.5dm^3 gave an astounding result against microbial growth. Nano Camphora products are only intended to confer antimicrobial protection to treated apparel. For household usage, 858g (that is less than 1kg) of Camphora can be ground into nano particle and dissolved in 10 litres of water, this can be used as a final rinse for various apparels.

Nano Camphora also solves the problem of unpleasant odor. It is quite affordable and can conveniently replace the exorbitant ones of similar usage.

Diluted Vinegar did not confer any form of protection against Escherichia coli (E-coli; - anaerobic bacteria). This problem coupled with its nauseating sensation makes it unfit for use as a final rinse.

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