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Research Article

COMPATIBILITY OF NON-ALCOHOLIC, NON-ALLERGIC WATER BASED MICRO EMULSION PERFUMES FOR SKIN AND SILK FABRICS

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ABSTRACT

Nowadays perfumes have become as essentials in everyday life. Recent studies reveal that alcohols used as a solvent and few fragrance chemicals have found to have a toxic effect on human health, especially about respiratory symptoms, allergy, autism, asthma, skin disease and eczema. Apart from this, because of Volatile Organic Chemical (VOC) restrictions, environmental pressures in Europe and religious constraints in Islamic nations, there is a need to open up a new market segment of non alcoholic fine fragrances. Water- based micro emulsion as perfumes will be a healthy alternative in that case. Many people apply perfume on clothes not only to cover unpleasant smell but also to protect themselves from perfumes that are thought to be allergic for skin and body. Hence this paper aims to study the effect of water- based perfumes on the skin for contact allergy and colored silk fabric based on mechanical properties (abrasion, tensile strength, pilling, etc.) as well as the colour fastness properties.

Keywords: micro emulsion, patch test, ROAT, silk fabric, water based perfumes.

INTRODUCTION

A Perfume is a creative composition of blends of fragrant materials in an alcoholic solution. Fragrances are volatile compounds and are constantly released into the air. Perfume ingredients, whether they are derived from natural resources or manufactured synthetic chemicals, may cause health or environmental problems when used because of volatile odoriferous components (VOCs) present in them[1].Still now, ethanol is the most widely used solvent during the manufacture of perfumes and colognes. As ethanol can solubilize the most of the ingredients used in perfumes, it is widely used by perfumers. Because it is a very good solvent, it helps to add each ingredient at the desired concentration and helps to achieve a transparent solution. Hence, ethanol is the major ingredient, usually between 50 to 95% per volume used in most of the perfumes and colognes sold in the market[2].

But in the literature, it is reported that ethanol is proved to be one of the causes of allergic contact dermatitis[3].It has been shown that approximately 2% of the general population is allergic to perfumes.Also, the other problems like volatile organic chemical restrictions imposed by different countries, protests from environmental organizations, people concerned with children safety and objections to alcohol based perfumes in some religiously based countries create the necessity for use of alcohol-free perfumes. A number of studies show that few fragrances either synthetic or natural origin cause cutaneous effects like irritation, photo toxicity, allergy, photo allergy and dermatitis of hands, face and armpits. Few researchers recorded respiratory and neurological effects due to the impact of odorous substances. Synthetic perfumes, which contain toxic petroleum- and coal-derived synthetic chemicals, may act as carcinogenic agents that have been linked to hormone, endocrine and reproductive system disruptions [4-10].

Hence, today consumers tend to prefer natural, organic and environmental friendly perfumes which are made from safe, pure ingredients that are free from petrochemicals, solvents, dyes, alcohol, and pesticides.

If water is used as a solvent for perfumes, there are limitations like limited solubility to fragrance oils, drying rates, odour diffusion, application method, appearance and skin feel. But Micro emulsion technology helps to remove these constraints and produce clear to opalescent water based fine fragrances[11-13].

Many times, people use perfume directly on clothes not only to cover the unpleasant smell but also to protect themselves from perfumes that are thought to be allergic for skin and body. Silk being luxurious and lustrous, it is preferred on special occasions, parties and festivals while the use of Perfumes also essential in that situation. Hence it is expected to spray perfumes on the fabrics directly, but silk is very sensitive to alcohol and prone to colour staining. So, an alternate non-alcoholic perfume is to be formulated. Hence this paper aims to investigate the performance of water based micro emulsion perfumes on skin and properties of silk fabrics.

MATERIALS AND METHODS

Pure mulberry silk fabrics made in plain weave, dyed with acid dyes in light, medium and dark shades were sourced from Central Silk Board, Bangalore. Fragrance materials, citronellal, lemon grass oil and vanillin were purchased from Indian Attar store, Coimbatore. Solubilizes and other chemicals were purchased from Sri Mahalakshmi Scientific company, Coimbatore. Distilled water used for remaining formulations.

Micro Emulsion Preparation

Citronellal, lemon grass and vanillin are used as top, middle and base notes. All these fragrance oils are first added in clean, dry glass vial. Polysorbate was added and stirred well for 5 minutes, followed with 5ml of PEG 40 as per proportion in given in Table 1. When fragrance oils were thoroughly mixed with solubliser, required quantity of water was added and stirred along with anti foaming agents and preservatives. After approximately 15 minutes stirring at slow speed at room temperature, a stable, fluid and transparent micro emulsion was obtained and closed with air tight stopper.

Table 1: Water based perfume formulation

Ingredients	Quantity
Fragrance oils	18 ml
Solubilizes(Polysorbate20)	20 ml
Co surfactant (PEG 40)	5ml
Anti-foaming agents	0.1g
Preservatives	0.1g
Distilled water	q.s to 100 ml

For comparison purpose, same fragrance oils are dissolved in ethanol and used for testing. Fragrance oils are added with denaturated alcohol as per proportion given in the table 2. It was mixed by stirring slowly but long enough to ensure complete dispersal and kept for 48 hrs in air tight container.

Table 2: Alcohol based perfume formulation

Ingredients	Quantity
Ethanol	70 ml
Distilled water	12 ml
Fragrance oils	18 ml
Preservatives	0.5 ml
U-v absorbent	1 ml

Application of perfume on fabric

A constant amount of 0.25ml/100 sq.cms was selected to spray on fabric samples from 15cm distance. Similar to actual spray conditions, the perfume was applied onto the fabric by simply spaying from the container with the right angle to maintain uniform condition throughout the study.

Measurements of Fabric Properties

The woven silk fabric properties like ends per inch and picks per inch were counted using the counting glass. The tensile strength, abrasion resistance, pilling, colour fastness to washing, drycleaning and perspiration were determined as per the ISO 13934-2:2004(Grab method), ISO 12947-2:1998, ISO 12945-2:2000, ISO 105-C 10: 2006, ISO 105-D01:2010 and ISO 105-E04:2008 standard methods respectively.

Spectrophotometer

Colour change and colour staining were assessed using ΔE values using Reflectance Spectrophotometer (Minolta CM 3600d).

FTIR Analysis

The fabric surfaces without and with perfume sprayed samples were studied by FTIR spectroscopy using Shimadzu IRAffinity-1S FTIR spectrophotometer. The mid-infrared region from 400 cm^{-1} to 4000 cm^{-1} was used.

ROAT Method

As per the repeated open application test (ROAT) METHOD, water based perfume prepared was applied twice daily for 7 days to the outer aspect of the upper arm. The size of the test area is 5cm x5cm and 0.1 ml was sprayed using a syringe.

Patch Testing

Water based perfume solution was placed in direct contact with the skin, on the upper back, within small aluminum disc patch. Testing portion was marked and patches were fixed using adhesive tape. The patch areas were neither washed nor exposed to sunlight. The patches were removed after 48 hours and an initial reading was recorded one hour later. Any change on skin surface was observed further 48 hours later and recorded as final reading

RESULTS AND DISCUSSION

Silk Fabric Properties

The properties of silk fabric in three different shades selected for study were listed in Table 3.

Table 3: Physical parameters of silk fabrics

Fabrics	EPI	PPI	GSM	Thickness (mm)
Blue	94	90	62	0.20
Pink	93	81	60	0.18
Ivory	96	91	69	0.19

Perfume Properties

Characterization of ethanol based and water based perfumes prepared were listed in the table 4.

Table 4: Properties of perfumes

Parameters	Alcohol Based	Water Based
Specific gravity	0.9495 kg/m^3	1.0122 kg/m^3
Refractive index	1.373	1.344
pH	5.85	5.16
Colour	light yellow, transparent	colourless transparent

The average size of particles in emulsion is 37.1nm and results of size distribution by intensity are shown in Figure 1.

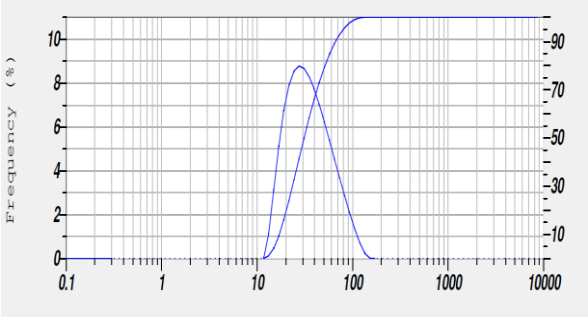

Figure 1: Particle size distribution of water based micro emulsion perfume

Contact Allergy Tests

ROAT test was done for 70 adult college students, with 90% girls and 10% boys with water based perfumes. A constant quantity of 0.1ml was sprayed on the marked area of the hand.99% of them reported no irritation or redness. In patch test also no symptoms of allergy, irritation, redness reported even

after 48 hours. Since all the ingredients are natural and used as very small percentage and water as solvent, water based perfumes will be very good alternative to ordinary perfume.

Figure 2: Patch test at hand

Mechanical Properties of Fabric Treated with Perfumes

Two different amounts of perfume, 0.25ml and 0.5ml were sprayed on the sample and subjected to different physical testing. The tensile strength of fabric treated with alcohol based and water based perfumes is shown in the Figure 3 & 4. Abrasion resistance values of fabrics are shown in Figure 5&6. Pilling grade values for fabric tested under different cycles were listed in Table 5.

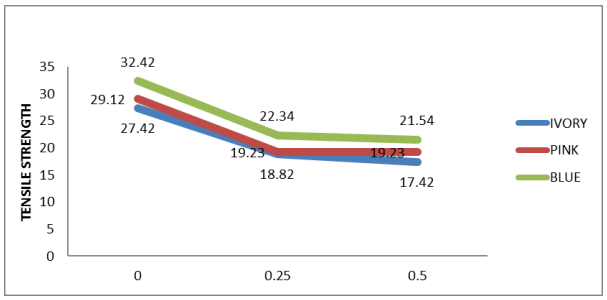

Figure 3: Tensile strength of silk fabrics when ethanol based perfume sprayed in different amount

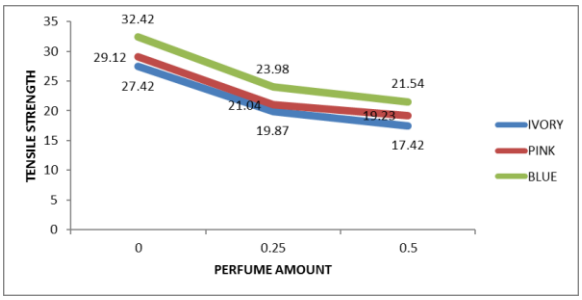

Figure 4: Tensile strength of silk fabrics when water based perfume is sprayed in different amount

Resistance to Abrasion

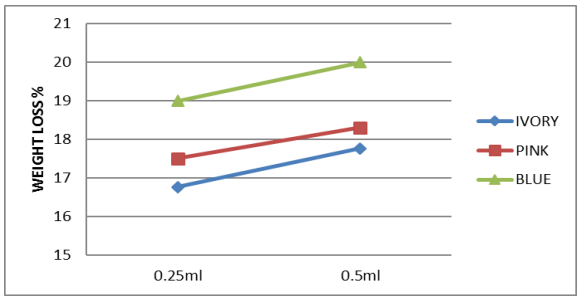

Figure 5: Abrasion resistance of silk fabrics when ethanol based perfume is sprayed in different amount

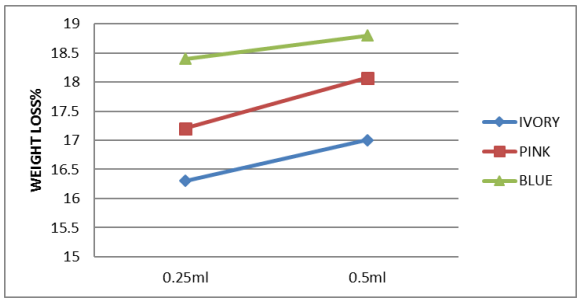

Figure 6: Abrasion resistance of silk fabrics when water based perfume is sprayed in different amount

Resistance to Pilling

Table 5: Pilling grade values observed for different cycles

	Without perfume			Ethanol perfume			Water perfume		
Fabrics	Ivory	Pink	Blue	Ivory	Pink	Blue	Ivory	Pink	Blue
Grade after 125 cycles	5	5	5	5	5	5	5	5	5
Grade after 500 cycles	5	5	5	5	5	5	5	5	5
Grade after 1000 cycles	5	5	5	5	5	5	5	5	5
Grade after 2000 cycles	5	5	5	5	5	5	5	5	5
Grade after 5000 cycles	5	5	5	4	4	4	4	4	4
Grade after 7000 cycles	5	5	5	4	4	4	4	4	4
Grade after 10000 cycles	5	5	5	4	4	4	4	4	4

Colour Fastness Properties of Fabric Treated with Perfumes

Ethanol based and water based perfumes were sprayed on the fabric samples were subjected to washing, dry cleaning, perspiration fastness tests. Change in colour was measured using Spectrophotometer and shown in Table 6 and Figures 7 & 8.

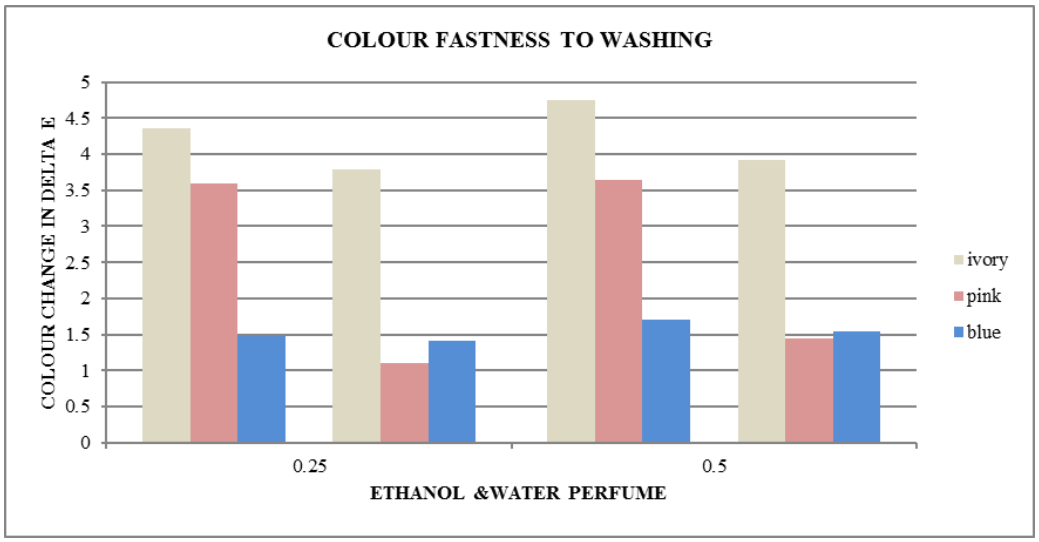

Figure 7: Colour change in fabric when perfume sprayed sample tested for washing

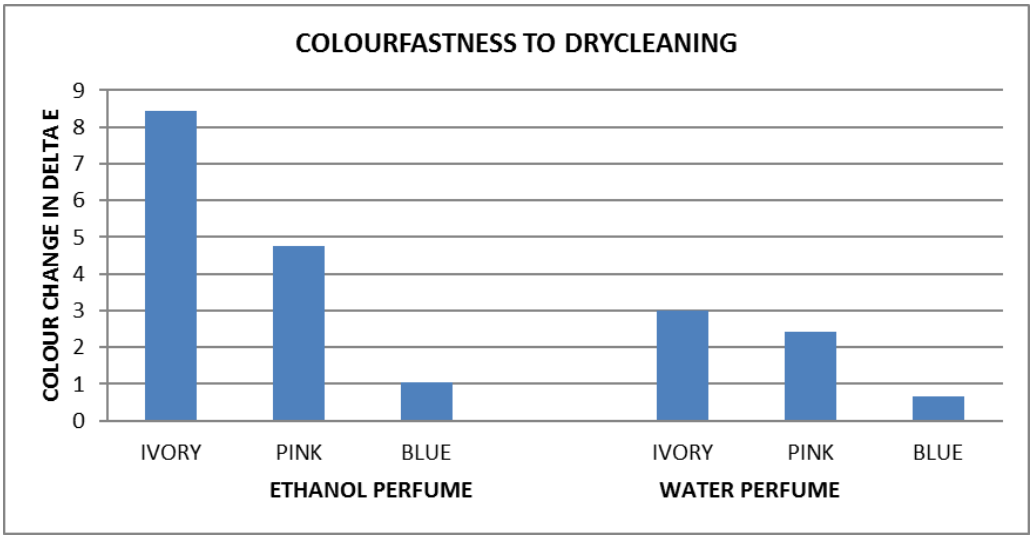

Figure 8: Colour change in fabric when perfume sprayed sample tested for dry cleaning

Table 6: Colour change in delta e value under colourfastness to perspiration

	Alkaline perspiration						Acidic Perspiration					
	Ethanol perfume			Water perfume			Ethanol perfume			Water perfume		
Fabrics	Ivory	Pink	Blue	Ivory	Pink	Blue	Ivory	Pink	Blue	Ivory	Pink	Blue
Delta E (0.25ml)	5.86	2.04	1.55	5	1.95	1.43	4.68	2.17	1.35	3.01	1.24	1.07
Delta E (0.5ml)	6.16	2.19	1.74	5.39	2.04	1.22	5.12	2.11	1.36	3.78	1.04	1.29

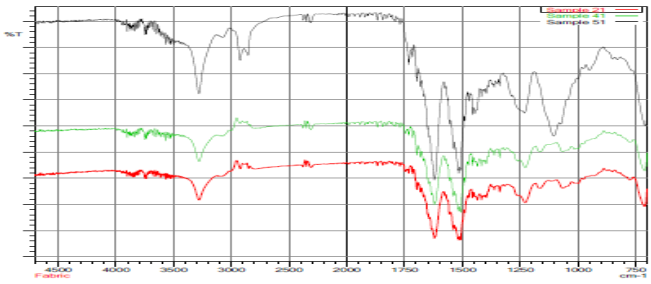

Figure 9: Ivory fabric without perfume, with alcohol, with water based perfume

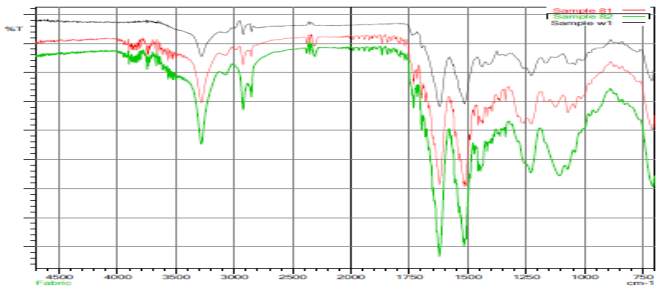

Figure 10: Pink fabric without perfume, with alcohol, with water based perfume

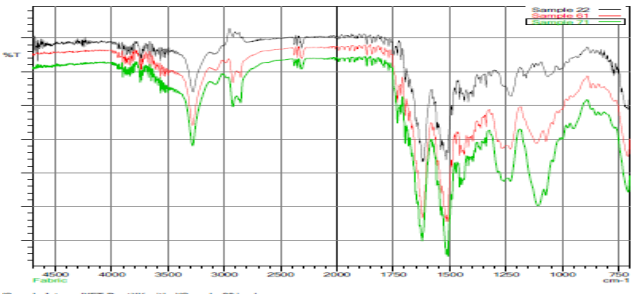

Figure 11: Blue fabric without perfume, with alcohol, with water based perfume

FTIR Results

To analyze any chemical change in the silk fibre due to perfumes, silk fabrics sprayed with perfumes were analyzed under FTIR. The transmittance curve of each fabric treated with ethanol based and water based perfumes along with fabrics without any perfume is shown in Figure 9-11.

DISCUSSION

As seen in the Figure1 and 2, the tensile strength of fabrics was in decreasing trend when perfumes were sprayed on it. But as silk is naturally strong filament, changes in strength were not significant with ethanol or water based perfumes and for increased amount. But it is very sensitive to abrasion and results in 16-20% weight loss when perfumes were sprayed.

From the table 5, it has been observed that both alcohol and water perfumes had no influence on fabrics for pill formation even when the perfume amount increases and also it was seen that both have the same grade as that of fabrics without perfume. This due to the fact that silk is a filament not a staple fibre and it has also been observed that pill formation is the consequence of increase in number of cycles.

When perfume sprayed samples were tested under washing, dry cleaning and perspiration, change in colour of the sample were measured in terms of Delta E value. When colour difference in Delta E value is up to 1.5, change in colour is acceptable. Increase in delta E Value indicates that three is noticeable colour change. In all these wet testing, ethanol based perfumes cause yellowing in light and medium colour and do not affect much in dark colour. The advantage of water based perfumes was evident as colour change is very less in Ivory and Pink fabrics.

In all three FTIR graphs, no new peak or change in the spectrum was noticed. The samples showed a slight difference in the spectrum that was indicated by using peak values. For eg, the peak value for the untreated sample is 1444.68 which is the same as alcohol perfume treated samples whereas water perfume treated samples has deepened peak value of 1446.61 The stretch that occurs in this frequency range is C=O group. The peak value 3280.92 of alcohol perfume treated samples and 3282.84 of water perfume treated samples occurs in this frequency range is O-H group. Similarly, the peak value 1444.68 and 1446.61 shows the stretch frequency range of C- H group.

This showed that there have been changes in peak values of alcohol, water and without perfume fabrics but the changes were compromised within the range of same frequency which represents that there were no major changes in chemical structure of silk fabrics due to fabrics and it reacted with surface level only.

CONCLUSION

As alcohol-free perfumes are in demand nowadays due to health issues, suitability of water based perfumes for skin and silk fabrics were studied. ROAT and patch test shows that water based micro emulsion perfumes, with selected fragrances are skin friendly and safe to use. The silk fabric test results showed there were slighter changes in tensile strength and abrasion resistance values and no changes in pilling for both alcohol perfumed samples and water perfumed samples. Also, the delta E values showed that the perfume treatment on silk fabric affected the lightness of the colour negatively. It is proven from the delta E values, that there is less colour change in water based perfumes than ethanol based perfume. FTIR spectroscopy result was verified for untreated and perfume treated (water perfume and alcohol perfume) samples and it is seen that there were no major changes in chemical structure.

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