

Enhancement of Wash Resistance and Functionality in Hair Colouring by Sodium Methyl Cocoyl Taurate and Sodium Myristoyl Sarcosinate based Formulae.

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Summary

The effects on hair colouring performances, on colour retention and conditioning of dyed hair after treatments with formulae containing sodium N-methyl-N-cocoyl taurate and sodium myristoyl sarcosinate (MCT-MS) in a new blend were studied. Hair colouring was performed with a permanent hair dye formula and with a semi-permanent hair dye formula. Three variants containing respectively the new blend or reference surfactants (sodium laureth sulphate – SLES - or cocamidopropyl betaine - CAPB) were tested. Washing fastness, expressed as decrease of initial colour intensity and increase of luminosity, were evaluated instrumentally, after 10 (permanent dyes) or 5 (semi-permanent dyes) wash cycles with SLES solution. Sensory parameters as colour homogeneity, brightness, colour intensity, conditioning/softness were also evaluated. MCT-MS exhibited superior foam height under strong energy impact than SLES. Associated surfactants provided in many cases synergistic enhancement of foam volume and improvements of foam quality. MCT-MS based oxidation hair dye showed the same colour uptake as the benchmarks and the same or better colour stability after washing. In the case of semi-permanent dye formula, initial covering and colour intensity stability were better for formulae with CAPB or with MCT-MS than with SLES, while hue changes were significantly lower for the formula with MCT-MS. In a comparison between a standard SLES-cocamide DEA shampoo formula and a MCT-MS shampoo formula, sensory parameters like hair conditioning, colour maintenance and homogeneity, showed improved results for the latter. These evaluations

confirm that cleansing with taurate-sarcosinate based shampoo provides statistically better hair conditioning and long-lasting colour permanence on dyed hair.

Introduction

Long fatty chain derivatives of taurine, e.g. N-acyl-N-methyl taurates [1,2], have been shown to decrease dandruff and protect hair from cuticle damages [3,4,5]. Moreover, scalp cells turnover was shown not to be increased by treatment with acyl taurates [6,7]. Acyl sarcosinates are known for their foaming power, and hair conditioning properties [8]. These reasons led us to prepare a combined blend of the two ingredients. This was tested for colour deposition from hair dyes and for hair colour stability after several washing cycles. Sensory parameters were also investigated, as they provide an indication of consumers' self-assessment of performances.

Study description

Materials and methods

A new blend of N-methyl-N-cocoyl-taurate with myristoyl sarcosinate, (MCT-MS) produced by Zschimmer & Schwarz Italiana was tested. Other common foaming surfactants e.g. sodium laureth sulphate (SLES), cocamidopropyl betaine (CAPB), disodium laureth sulpho-succinate (SLSS), disodium cocoanfoglycinate (SCAG), magnesium laureth sulphate (MLES) or myristoyl sarcosinate (MS) from the same company were used in the study. Other blending surfactants included coco-glucoside (CG) from Cognis, Germany, while as foam boosters PEG-90 glyceryl isostearate + laureth-2 (OVD), or cocamide DEA (CDE) from Zschimmer & Schwarz Italia, or PEG-120 methyl glucose dioleate (MGD) from Degussa Germany were used.

Foam Stability

Evaluations of foam height and foam stability were carried out with two different methods. In the first (A), which produces foam under high energy input, foam was formed from 100 ml a 0,5% SAL solution of the tested blend, in a becker (400 mL), homogenized for 1' at

600 rpm with turbine. Foam was draught into a 250 mL cylinder, internal diameter 35 mm. After 1', the foam height in mm was measured (h°). Measure was repeated after additional 5' (h'). Foam stability was calculated as $(h'/h^{\circ}) \times 100$. Then, a low energy input method (B), was applied. Foam was formed from aqueous solutions at the same concentration as above. 100 mL solution was put in a 250 ml glass cylinder and shaken 10 times by turning it upside-down. Foam height and stability were also determined as before described. A sensory method was used for determining foam quality. A five point scale was applied to sensory parameters of foam quality: thickness, wetting, body, resistance, elasticity. Bubble visual dimensions were also evaluated and ranked.

Hair colouring:

Hair tresses were yak white hairs, supplied by Lo Curcio, Palermo. Two types of colouring formulations have been tested on hair swatches. Formulations of permanent hair dye were based on (decreasing INCI order): aqua, propylene glycol, cetyl alcohol, steareth-21, glycerine, steareth-2, dimethicone, ammonia, 4-ammino-2-hydroxy-toluene, p-phenylen-diammine, containing also standard antioxidants and sequestering agents, while surfactants used (at 4% a.m.) in comparison experiments were respectively SLES (formula A) or CAPB (B) or the surfactant blend MCT-MS (C). Semi-permanent dye formulae were made with a surfactant blend containing MCT-MS with SCAG and MLES (formula C') and semi-permanent dyes (HC Blue n°2, Disperse black 9, HC Yellow 4, Disperse Violet 1, Disperse Blue 3, HC Yellow 5, HC Red n°3, Basic red 2). In reference formulae, respectively 3% a.m. SLES (A'), or CAPB (B') were used instead of MCT-MS. Measurements of the colour intensity of the tresses (L^* , a^* or b^* para-meters) was carried out with a Minolta Colorimeter on the tip, middle and root of the hair. Values were then averaged for simplicity. A trained sensory group of three judges evaluated colour homogeneity, brightness, intensity and conditioning/softness of hair tresses.

Washing fastness

Washing fastness of coloured tresses were evaluated by repeated series of ten (for permanent hair dye) and five (temporary hair dye) standard wash and rinse cycles with a normal SLES-CDE based shampoo. In another set of studies, the same cycles were repeated while comparing a MCT-MS based (6% a.m. - Formula B'') shampoo (containing also SLSS 5% a.m., CG 3% a.m., OVD 2% a.m., Polyquaternium-16, MGD 1%, at pH 5.7) with a normal SLES-CDE (A'') based shampoo. In all cases, colour intensity (L^* and a^* or b^* according to the hue) were evaluated instrumentally as before. Sensory evaluation was carried out as before, on parameters of colour homogeneity, brightness, colour intensity, conditioning/softness. After each washing procedure, colorimetric colour intensity and sensory properties of the hair were evaluated in the same way. ΔL^* , Δa^* , Δb^* (absolute values), are the differences between the initial and the final values, while their percentage change, e.g. $\Delta(L^*_0 - L^*_x)/L^*_0 \times 100$, are calculated at the end of the wash cycle and reported when relevant.

Results

Foam evaluation

MCT-MS shows superior foam height under strong energy than SLES. Association with SLES in ratio 1:1 and 1:3 gives comparable high results in terms of foam height and very high foam quality. High foam stabilisation is obtained with CDE, mainly in terms of foam height at low energy impact and foam quality (Tab I). SLSS, MS, SCAG, CAPB plus their combinations, as associated surfactants provide high foam enhancements (Tab II).

Hair colouring (Permanent dye)

1) N-cocoyl-N-methyl taurate + myristoyl sarcosinate (MCT-MS) based oxidation hair dye (formula C) shows the same colour uptake (Fig. 1) of the ref. formulae (A with SLES, B with CAPB): initial values: $a^*(A)$ average: 13.6, $a^*(B)$ average: 15.3, $a^*(C)$ average: 14.5 (n.s. no significant difference).

2) MCT-MS based oxidation hair dye shows same colour stability (n.s.) as ref. formulae: after 10 washings $a^*(A)$ average: 13.8, $a^*(B)$ average: 14.0, $a^*(C)$ average: 13.3 (Fig. 1).

3) As far as fading of covering power after washing is concerned, MCT-MS based oxidation hair dye shows better covering stability than the two references, being the $\Delta L^*(A)$ average 5.1 (21.2%), $\Delta L^*(B)$ average 5.1 (19.9%), $\Delta L^*(C)$ average 3.8 (13.8%). This last difference is statistically significant ($p < 0.05$) compared to A or B formulae (Fig. 1).

Hair colouring (Semi-permanent dye)

1) In the case of semi-permanent dye formula, colour uptake was similar ($b^*(A')$ average: 11.9, $b^*(B')$ 12.4, $b^*(C')$ 10.8, n.s.) for the three formulae, while initial covering was better for B' and C': $L^*(A')$: 33.6, $L^*(B')$: 30.7, $L^*(C')$ 30.7 (Fig.2).

2) The MCT-MS semi-permanent hair dye shows the same colour stability as CAPB and SLES formula: after 5 washings $b^*(A')$ 14.2, $b^*(B')$ 14.0, $b^*(C')$ 12.6 (n.s.). Covering loss was comparable for the three formulae: $\Delta L^*(A')$ 13.5 (38.8%), $\Delta L^*(B')$ 15.7 (51.1%), $\Delta L^*(C')$ 15.3 (49.7%). On the contrary, hue changes, calculated as Δb^* was 2.5 units (19.5%) for A', 1.5 (12.1%) for B', and 1.8 (16.9%) for C'. Differences were statistically significant for formulae B' and C' ($p < 0.05$) (Fig.2).

Sensory parameters

Sensory parameters were comparable for the three semi-permanent dye formulae A', B' and C'. Indeed, colour homogeneity on hair (4.2, 4.3, 3.5) brightness (5.8, 5.8, 5.8) visual colour intensity (4.0, 4.0, 3.7) hair conditioning (5.8, 5.8, 5.8) respectively for formulae A', B', C' do not show significant differences.

Shampoo comparison - Colour fading after 10 wash cycles (permanent dye)

In the comparison between two shampoos, one based on SLES and the other on MCT-MS, the latter shows superior performances (Fig. 3): SLES formula ΔL was 3.9 +/- 0.5 units after 10 cycles (permanent dye) with a colour loss of 18%, while it was 0.5 +/- 0.5 (2.3 %) with the MCT-MS shampoo, colour change was 23% for SLES and 2.7% for MCT-MS (Δb^* % after 10 washes). Sensory evaluation also showed distinct results (SLES vs MCT-MS): colour homogeneity 4.6 vs. 5.0 respectively; brightness 5.6 vs. 5.9; colour intensity 4.2 vs. 4.5 and conditioning 6.4 vs. 7.2 (Fig. 5).

Shampoo comparison - Colour fading after 5 wash cycles (semi-permanent dye)

With semi-permanent dyes, colour coverage kept the same (Fig. 4) with the two types of cleansing formulae $\Delta L^*(A'')$ 7.5 (17.2%) and $\Delta L^*(B'')$ 8.7 (19.8%), while colour intensity (Δa^*) decreased by 0.6 (10.8%) for the SLES formula and 0.4 (6.8%) for the MCT-MS formula. Also in this case, sensory parameters were in favour of the MCT-MS formula. Colour homogeneity values were respectively (SLES vs. MCT-MS) 4.0 vs. 4.2, brightness 5.3 vs. 6.3, colour intensity 4.3 vs. 4.5. The best result was obtained for hair conditioning 5.3 vs. 6.7 ($p < 0.05$), showing that cleansing with taurate-sarcosinate blend based shampoo provides statistically better hair manageability and lower fly-away (Fig. 6).

Conclusions

The studied N-methyl-N-cocoyl taurate and myristoyl sarcosinate new blend shows significant improvements in the diffusion of colorants into the hair and in the capability to maintain the acquired shade. Additionally, sensory elements support the possibility of using this surfactant blend in hair colouring and colour fading proof formulations.

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Tab. I: Foam characteristics of MCT-MS, SLES and binary blends

	<u>h°</u> <u>method A</u>	<u>h'</u> <u>method A</u>	<u>%</u> <u>stability</u>	<u>h°</u> <u>method B</u>	<u>h'</u> <u>method B</u>	<u>Firmness</u>	<u>Bubble</u> <u>dimensions</u>
SLES	228	192	84,2	205	187	2	Medium-large
MCT-MS	260	235	90,4	195	185	3	Medium
SLES+MCTMS	255	224	87,8	195	180	3	Medium
SLSS+ MCTMS	290	270	93,1	185	150	2	Medium-small
MS + MCTMS	263	230	87,5	180	150	3	Medium
SCAG+ MCTMS	274	250	91,2	195	180	3	Medium
CAPB + MCTMS	263	238	90,5	200	175	3	Medium
CDE + MCTMS	255	236	92,5	190	175	4	Small
OVD + MCTMS	212	180	84,9	200	155	3	Medium
SLES + MCTMS 3:1	270	245	90,7	185	160	2	Medium

Tab. II: Foam characteristics of ternary blends (MCT-MS + x + y)

X +Y	<u>h°</u> <u>method A</u>	<u>h'</u> <u>method A</u>	<u>%</u> <u>stability</u>	<u>h°</u> <u>method B</u>	<u>h'</u> <u>method B</u>	<u>Firmness</u>	<u>Bubble</u> <u>dimensions</u>
SLES - SLSS	257	227	88,3	190	175	2	Medium
SLES - MS	263	232	88,2	185	165	3	Medium
SLES - SCAG	242	215	88,8	195	180	2	Medium-large
SLES - CAPB	295	277	93,9	195	177	4	Medium-small
SLSS - SCAG	293	272	92,8	193	180	4	Medium-small
SLSS - MS	265	238	89,8	170	155	3	Medium-large
MS - SCAG	280	258	92,1	190	183	3	Medium
CAPB - SLSS	274	244	89,1	190	175	3	Medium
CAPB - MS	285	265	93	195	177	3	Medium-small
CAPB - SCAG	268	240	89,6	190	170	3	Medium

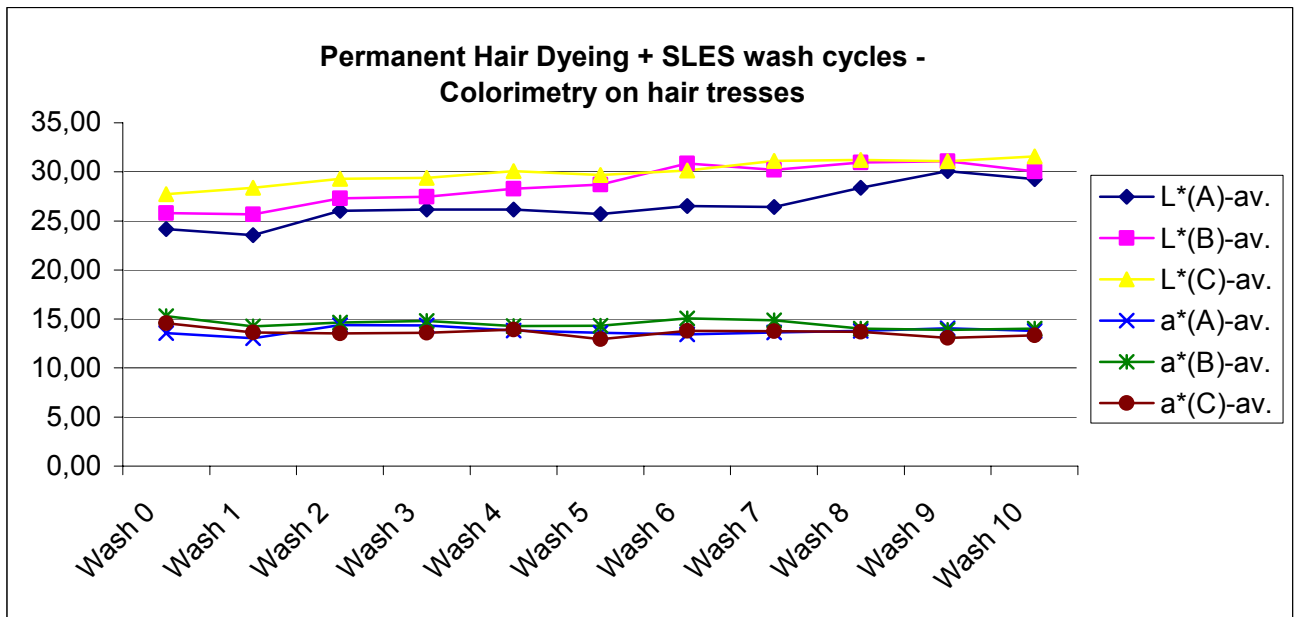


Fig. 1

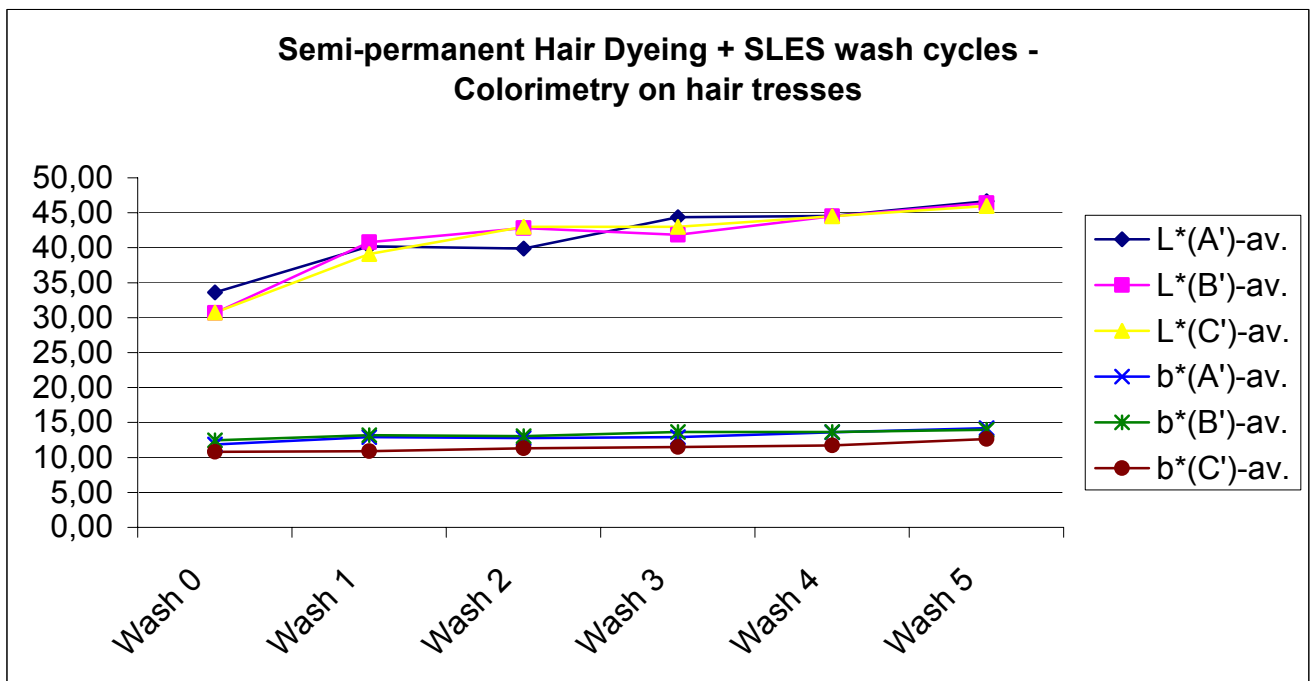


Fig. 2

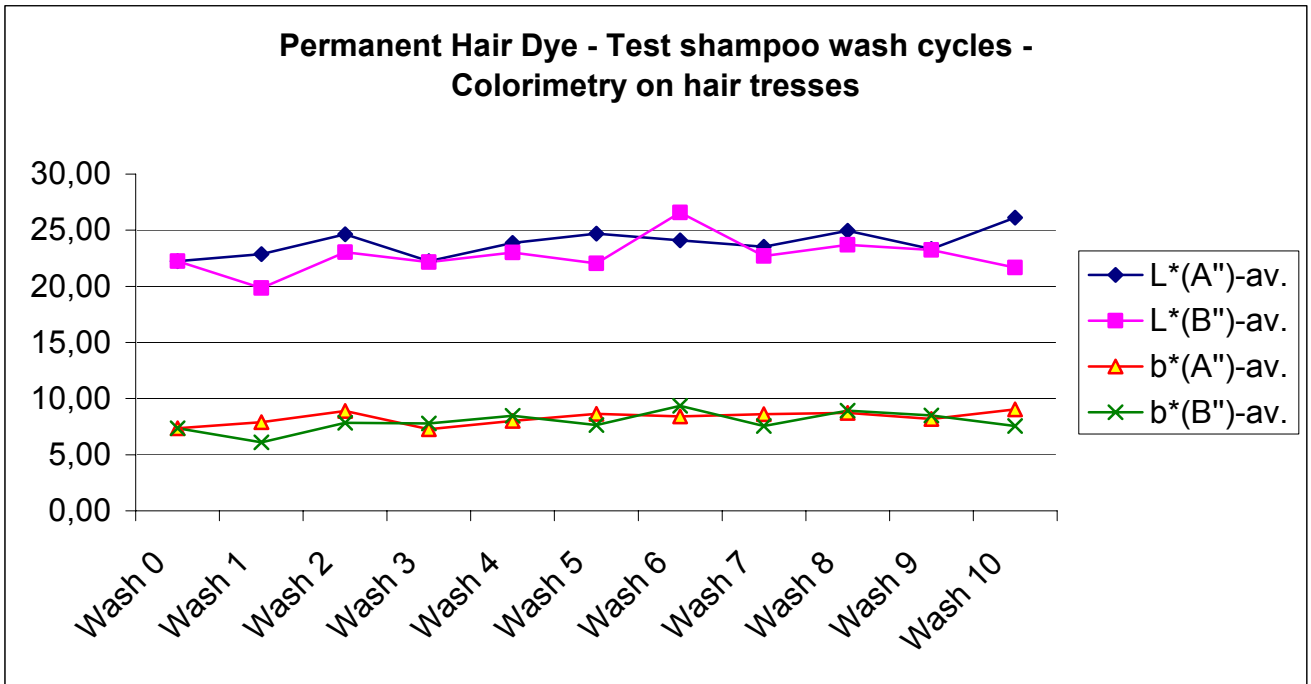


Fig. 3

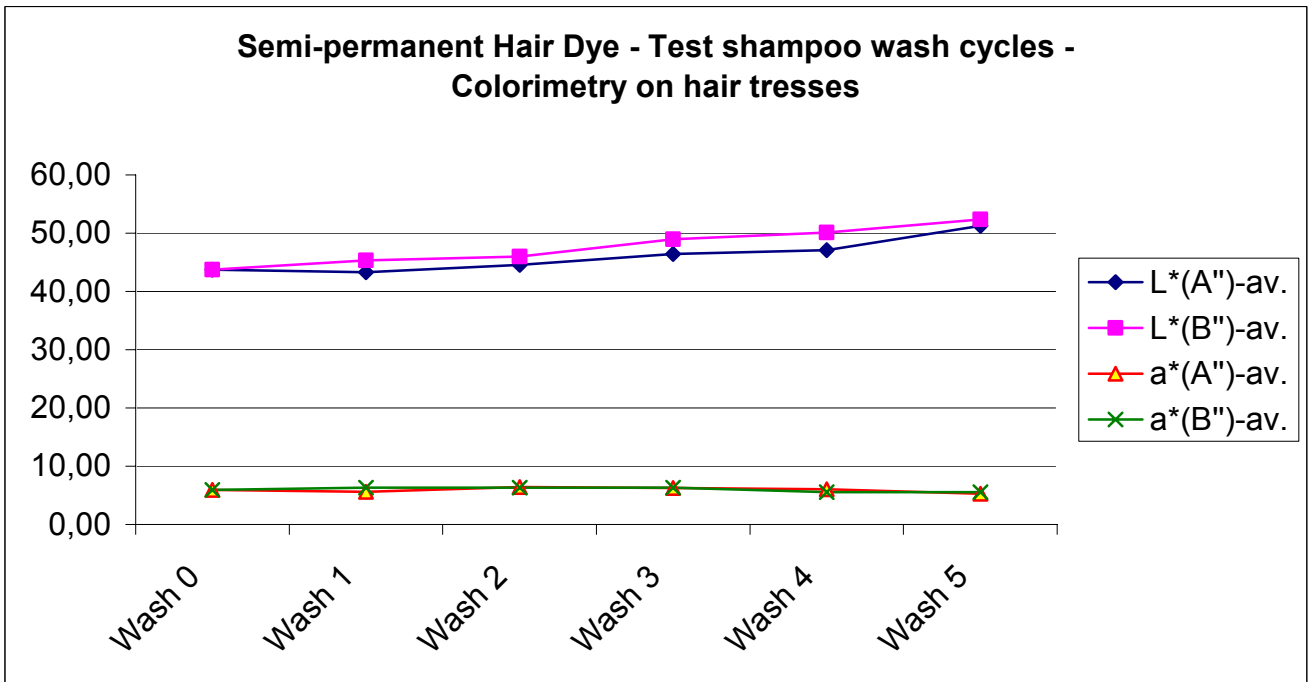


Fig. 4

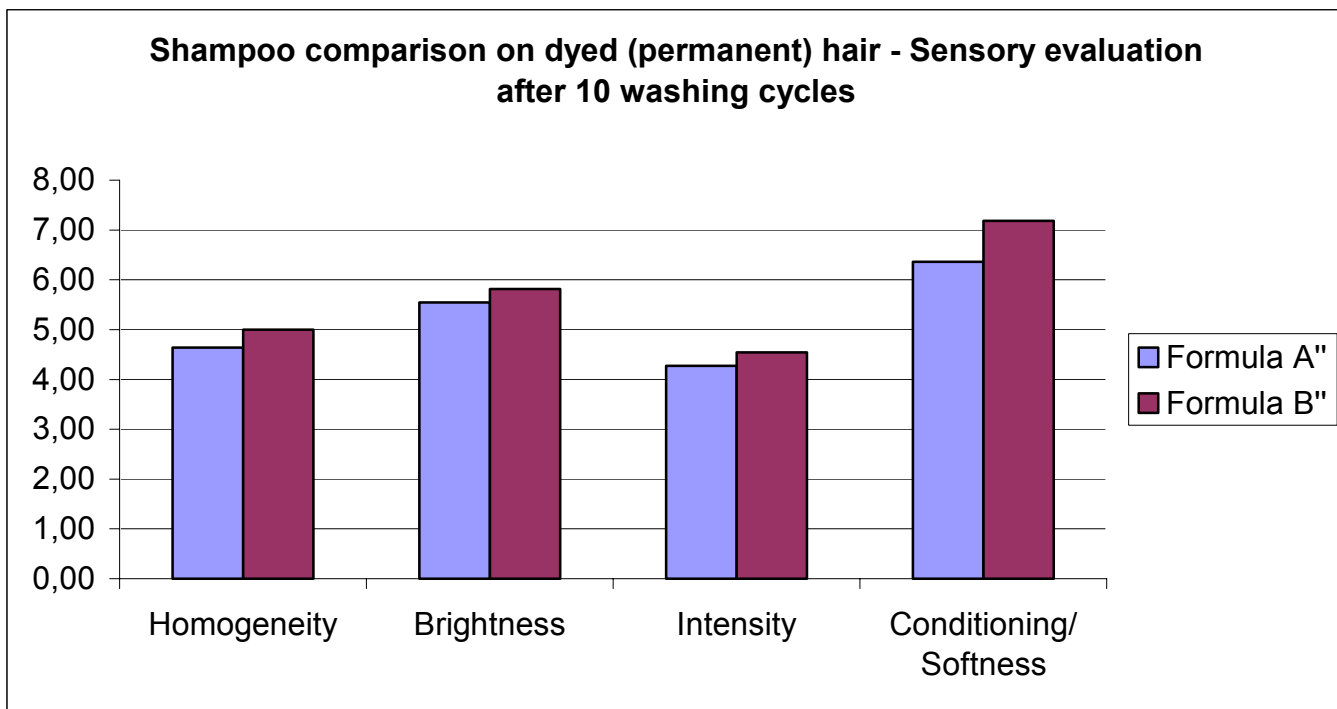


Fig. 5

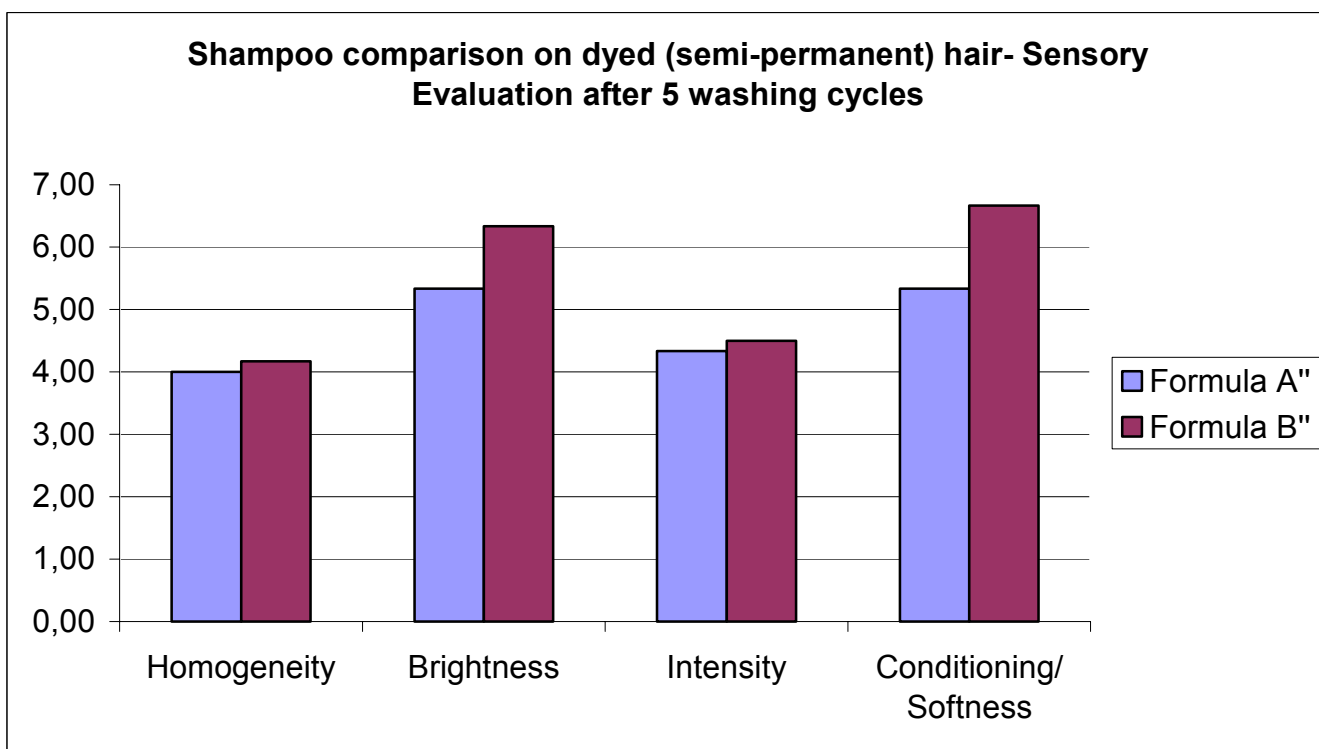


Fig. 6