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"Skin during pregnancy: explore its needs to develop a new multipurpose lotion"

Gaetan Boyer[1]*, Clarence de Belilovsky [1], Sophie Leclere [1], Franck Menu [1], Caroline Baudouin [1]

1 Laboratoires Expanscience, rue des Quatre Filles, 28233 EPERNON, FRANCE

1. Introduction

Pregnancy is a special stage in a woman's life. During this period, many physiological, hormonal and immunological changes appear [1]. The skin will also undergo significant mechanical deformations in certain areas such as the abdomen due to baby growth, which will modify its physical properties [2] and can lead to skin breakage, known as *striae distensae* or stretch mark. To date, while some studies have studied locally the properties of the skin during pregnancy and after childbirth in a given area [3,4], there is few knowledge about modifications of skin during pregnancy. The understanding of these modifications is important to understand the skin needs and develop specific products for women during this particular stage of their life.

The first objective of this work was to conduct a research program on pregnant women skin including 2 studies to understand its properties:

- a study of the comparison between normal and pregnant woman skin on normal appearing skin and red stretch marks during pregnancy and four months postpartum.
- a study of the variation of the skin properties during pregnancy on the abdomen area to evaluate the hypothesis that this area is solicited in a heterogeneous way with areas more at risk of developing stretch marks than others.

Following these studies, a specific multi purpose lotion for pregnant woman has been developed. The second objective of this work was to evaluate the perception and the efficacy of this multipurpose lotion on stretch mark with 2 studies:

- a study on preventive efficacy on women from beginning of pregnancy to 6 weeks after delivery.
- a study on correction efficacy on post-partum women with recent stretch marks.

2. Materials and Methods

Clinical exploration: comparison between non pregnant and pregnant women skin

A first study including 20 primipara pregnant women aged from 21 to 35 years old between 33 and 36 amenorrhea weeks presenting a BMI between 20 and 30 and red stretch marks on abdominal skin has been performed. Among these women 14 subjects have been followed for 4 months postpartum. Also, 15 nulliparae women have been included for comparison between pregnant and non-pregnant woman skin. Measurement performed were clinical scoring, Natural Moisturizing Factors (NMFs) and ceramides quantification from non-invasive samplings (swabs), inflammation using laser-doppler method, mechanical properties with suction test and reflectance confocal microscopy on red striae and normal appearing skin.

Clinical exploration: mapping of skin properties during pregnancy

A second study was carried out with 5 women aged from 24 to 34, primiparous, with measurements taken at 15 weeks, 28 weeks, 36 weeks of amenorrhea and 16 weeks after delivery in order to evaluate the cutaneous properties of abdomen during pregnancy. Assessments were performed on 25 measurement points which have been defined on one half of the abdomen. Measurement performed included hydration, transepidermal Water Loss (TEWL), mechanical properties with suction test, thickness and echogenicity of the skin using echography, and maximal circumference of the abdomen. Mapping of the properties related to each parameter has been performed by interpolation algorithm.

A global overview of measurements performed during the clinical exploration step is illustrated figure 1.

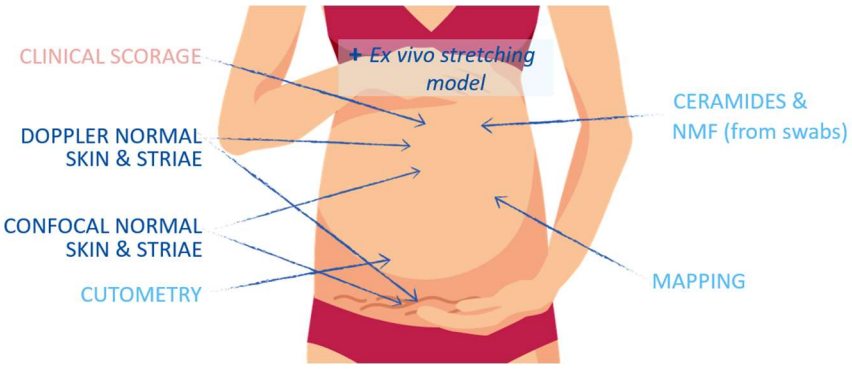

Figure 1. Global overview of the measurements performed during the clinical exploration step.

Following the clinical exploration step, a specific multipurpose lotion has been developed and assessed with 2 clinical studies.

Multipurpose lotion assessment: stretch mark prevention study

The objective of this first study was to evaluate the prevention efficacy on stretch marks of the multipurpose lotion during pregnancy. This study has been performed under dermatological and gynecological controls on 32 primipara (single fetus) female aged from 22 to 35 years-old (mean age: 29.9 months), with all types of skin, phototype (Fitzpatrick) from I to IV and a Body

Mass Index (before pregnancy) between 20 and 25. Women were included at 15 to 17 weeks amenorrhea.

The subjects applied the product on the body, in the morning and evening from the beginning of pregnancy to 6 weeks after delivery, by massage with circular movements on the concerned areas (breasts, belly, hips and thighs) until complete penetration.

The number of stretch marks (white/old and red/new) was recorded on the body (belly, breast, hips, thighs and buttocks). The counting was performed at the inclusion (15 weeks of amenorrhea, n=32 subjects), after 3 months of application (27 weeks of amenorrhea, n=31 subjects) and 6 weeks after delivery (n=18 subjects).

Additionally, a self-assessment questionnaire on the efficacy, cosmetic qualities, use appraisal and tolerance perception of the product was filled by the subjects after 3 months of application and 6 weeks after delivery.

Multipurpose lotion assessment: stretch mark correction study

The objective of this first study was to evaluate the correction efficacy on stretch marks of the multipurpose lotion on women after delivery. This study has been performed under dermatological control on 32 subjects, aged from 22 to 38 years-old (mean age: 30.2 months), with all types of skin, phototype (Fitzpatrick) from I to III and presenting recent red stretch marks (stage I in the Deprez-Adatto classification). Subjects were included from 0 day to 4 months post-delivery.

The subjects applied the product on recent stretch marks and surrounding area, twice a day by circular massage.

Measurement of one stretch mark properties choose by the dermatologist was performed at inclusion (n=32 subjects) and after 28 (n=32 subjects), 56 (n=30 subjects) and 84 (n=23 subjects) days of product application including:

- clinical scoring of color and aspect of the stretch mark and of the surrounding skin on a 9 points scale (Color of the stretch mark: 0: white to 9: red/purple. Aspect of the skin around the stretch mark: 0: smooth to 9: crumpled. Aspect of the stretch mark: 0: unpleasant to 9: pleasant).
- size measurement of the stretch mark on standardized photographs (width and length in mm).
- stretch mark visibility compared to the surrounding skin by chromameter (color difference using the ΔE parameter).

Additionally a self-assessment questionnaire of the efficacy, cosmetic qualities, use appraisal and tolerance perception of the product was filled by the subjects after 28, 56 and 84 days of product application.

3. Results

Clinical exploration: comparison between non pregnant and pregnant women skin

Results show that the pruritus was extensive during pregnancy and postpartum with high intensity on tension zones (abdomen). Pigmentation disorders were observed during pregnancy and also after delivery. On normal abdomen appearing skin, a decrease of NMFs and ceramides were objectivated during pregnancy, and the levels of both did not come back to normal after delivery. These results are illustrated figure 2.

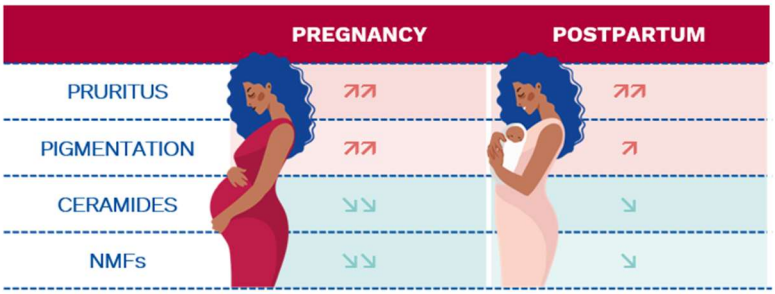

Figure 2. Qualitative illustration of pruritus, pigmentation, ceramides and NMFs differences between normal skin and skin during pregnancy and postpartum.
↗: increase, ↗↗: high increase, ↘: decrease, ↘↘: high decrease.

Skin inflammation of pregnant women abdomen was detected by clinical redness scoring and also by an increase of the blood flow assessed by doppler laser as illustrated figure 3. Inflammation also persists after delivery.

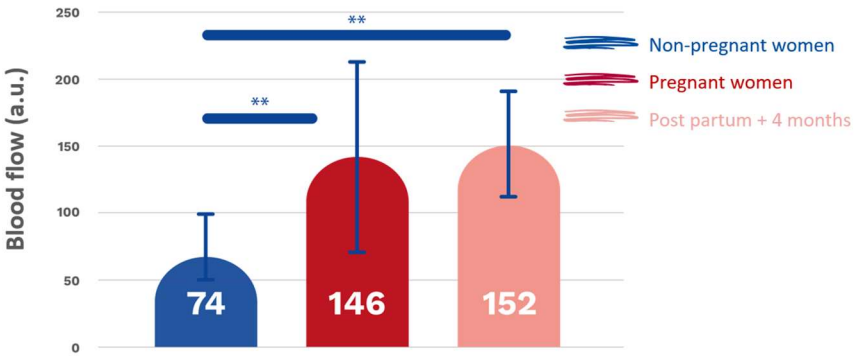

Figure 3. Skin inflammation assessed by doppler laser on non-pregnant women and women before and after delivery. Bars with stars indicate significant difference $p<0.05$.

Suction measurement results show that the mechanical properties are also highly impacted by the pregnancy. The mean curves of the suction test are represented figure 4, illustrating the difference of behavior for each group.

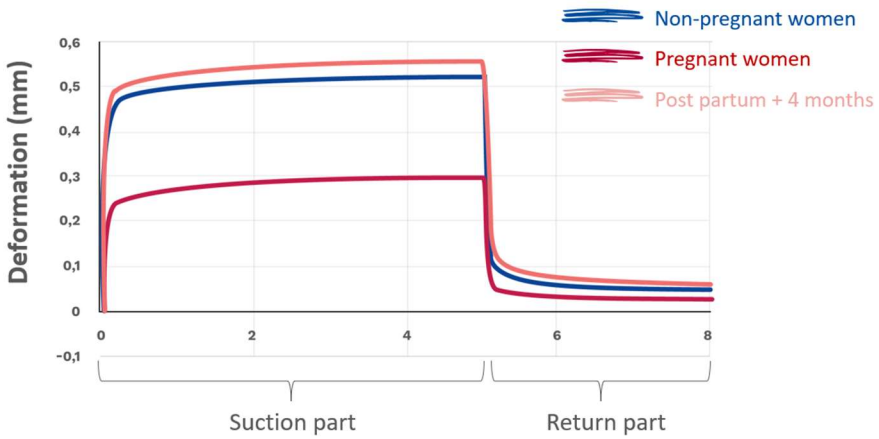

Figure 4. Average curves of the suction test for each group.

Maximum extensibility drops during pregnancy and becomes higher after delivery, traducing a loss of firmness. Differences on the return part of the skin to its initial state is also observable traducing a loss of tonicity. Values for each group for maximum extensibility Uf and for the tonicity ratio Ur/Uf are illustrated figure 5.

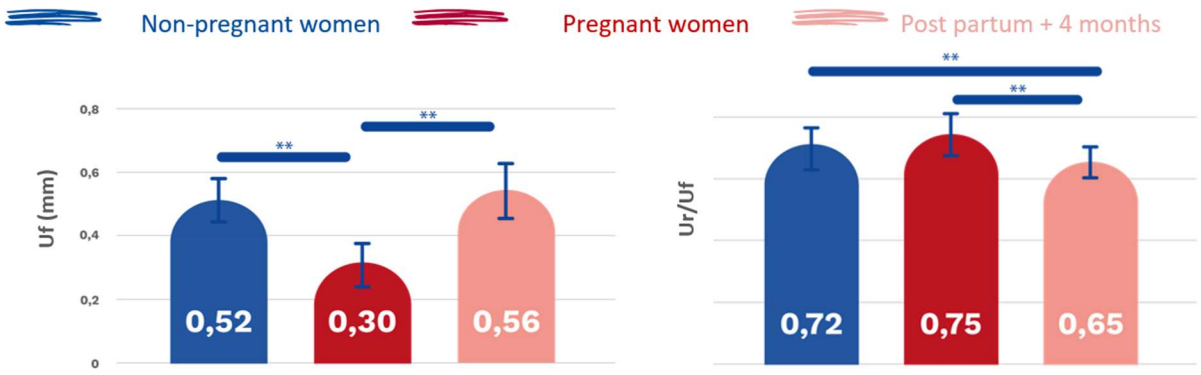

Figure 5. Maximum extensibility Uf (mm) and tonicity ratio Ur/Uf for each group. Bars with stars indicate significant difference $p<0.05$.

Acquisitions performed by reflectance confocal microscopy of red stretch marks showed many differences with normal skin. Results show a lower density of dermal papillae, with elongation and disorganized collagen and inflammation. The 3 last abnormalities persisted in postpartum. Results also show a decrease of brilliant cells at the dermo-epidermal junction confirming the inflammation of the skin. These observations are illustrated figure 6.

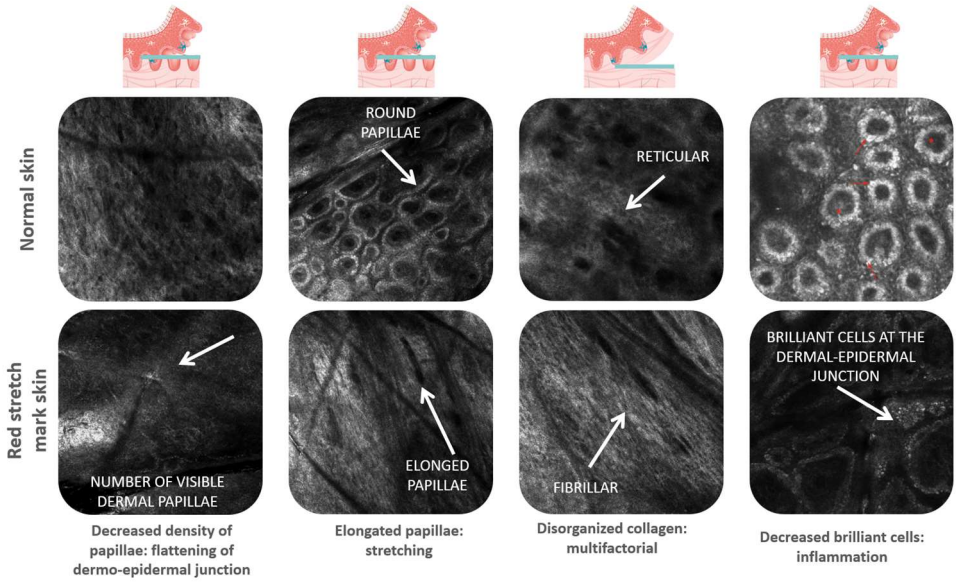

Figure 6. Confocal microscopy acquisitions illustrating the differences observed between normal skin and red stretch mark skin.

Clinical exploration: mapping of properties during pregnancy

The mapping study show that for the 5 subjects the physical properties of the abdomen skin vary during the pregnancy with high spatial heterogeneity. These variations and heterogeneities are quite similar between subjects for all parameters except one subject in terms of hydration during pregnancy. The intra-individual variations during pregnancy are high: from 188.9% to 414.3% for hydration, from 68.4% to 217.9% for TEWL, from 144.4% to 209.4% for extensibility (Uf measured by Cutometer) and 92.7 % to 128.9% for thickness. The maps obtained clearly show the impact of pregnancy 6 weeks after delivery, especially in terms of extensibility and thickness but also in terms of the skin barrier (TEWL). Maps for subject 1, subject 2 and subject 3 are illustrated figure 7 for hydration, TEWL, thickness and extensibility.

The evolution of the maximum abdomen circumference for each subject is illustrated figure 8. The variation of the circumference between the beginning of pregnancy and 16 weeks after delivery is quite minimal, ranging from -1.66% to 1.47%.

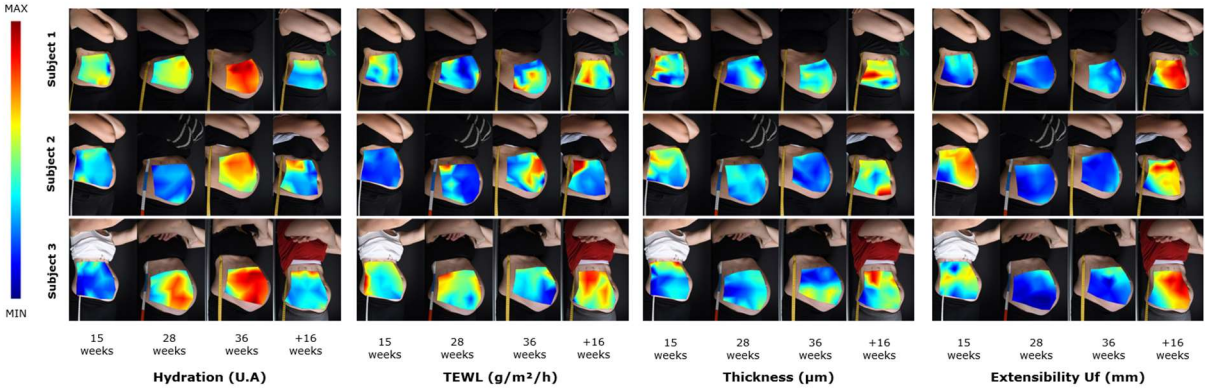

Figure 7. Global overview of the measurements performed during the clinical exploration step.

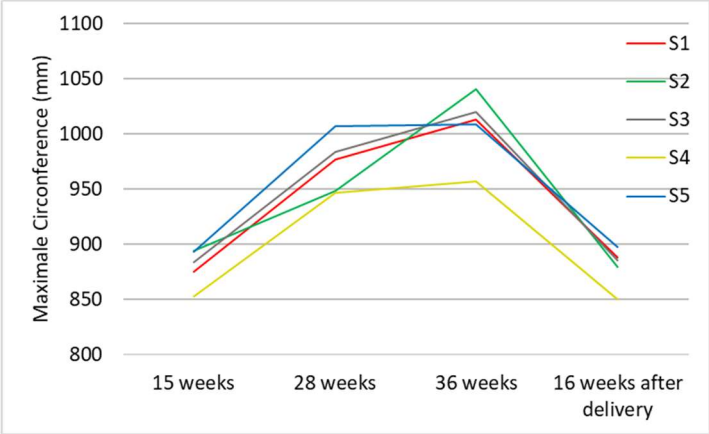

Figure 8. Maximum abdomen circumference for each subject during the study.

Multipurpose lotion assessment: stretch mark prevention study

The percentages of subjects without Red/New stretch marks for each body area are in table 1.

	Total	Belly	Breast	Hips	Thighs	Buttocks
D0 (n=31)	83.3%	94.4%	88.9%	88.9%	100%	100%
DEnd (n=18)	77.8%	83.3%	83.3%	88.9%	88.9%	100%

Table 1. Percentages of subjects without Red/New stretch marks for each body area.

Globally, the multipurpose lotion limits the appearance of stretch marks. Only 22% of women developed new ones whereas the mean prevalence expected of subjects with new striae is about 70% (50-90%).

The efficacy of the multipurpose lotion was well-perceived according to the self assessment questionnaire for example on the prevention efficacy, improvement of skin elasticity and hydration (respectively 94.4%, 88.9% and 83.3% of satisfied subjects). Cosmetics qualities were also appreciated. The texture is perceived light and non sticky (respectively 83.3% and 88.9% of satisfied subjects).

Multipurpose lotion assessment: stretch mark correction study

The results of the clinical scoring, stretch mark size and visibility of the stretch mark with the surrounding skin at inclusion (D0) and after 84 days of application (D84) are in table 2.

Parameter	D0 (mean ± sd)	D84 (mean ± sd)	Δ%	P value	% of subjects with positive evolution
Clinical scoring of color of the stretch mark	8,13±0,7	6,39±1,1	-21,4%	p<0.05	95,7%
Clinical scoring of aspect of the skin around the stretch mark	5,17±1,5	4,35±1,5	-16%	p<0.05	82,6%
Clinical scoring of aspect of the stretch mark	4,48±1,7	5,48±1,8	22,3%	p<0.05	78,3%
Width of the stretch mark (mm)	5,05±2,6	3,87±1,8	-23,4%	p<0.05	87%
Length of the stretch mark (mm)	43,33±18,4	32,66±17,4	-24,6%	p<0.05	91,3%
ΔE Stretch mark/Surrounding area	6,52±2,7	4,63±2,4	-29,1%	p<0.05	82,6%

Table 2. Results of clinical scoring, size measurement and visibility of the stretch mark. P value correspond to the statistical analysis of parameters between D0 and D84.

After 84 days, there is a significant improvement of the color, aspect width, length and visibility of the stretch mark. The stretch mark size (width and length) signicantly decreased. An illustration of the improvement for one stretch mark is illustrated below.

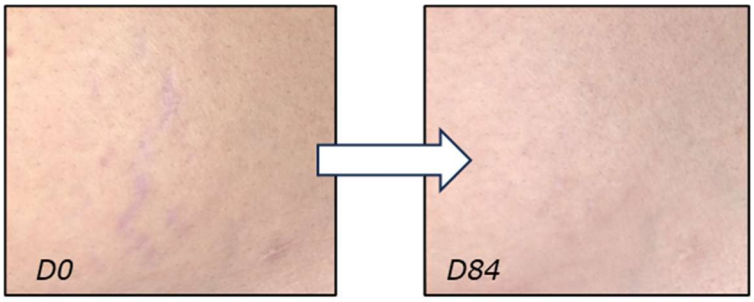

Figure 2. Illustration of one stretch mark at D0 and D84.

The efficacy of the product was also perceived through the self-assessment questionnaire. After 84 days of use, subjects found that the product made the skin more comfortable and improved the color of stretch marks (91.3% and 82.6% of satisfied subjects, respectively).

4. Discussion

Knowing the properties of the pregnant woman's skin is essential to ensure her well-being. During pregnancy, significant hormonal changes impact the texture, sensitivity and elasticity of the skin. Understanding these transformations makes it possible to better adapt skin care by choosing active ingredients adapted to the needs of the skin.

The first part of this work highlighted the changes in the properties of the pregnant woman's skin, particularly in the abdomen area. Normal appearing skin undergoes multiple modifications during pregnancy, without normalization after 4 months post-partum. In red striae, stretching induces alterations of skin structure and dermal fibers as well as skin inflammation. It has also been shown that there is a great heterogeneity in the modification of the properties of the belly during pregnancy, which certainly creates areas that are more likely to develop stretch marks.

Based on the results of this first part, a multi purpose lotion product has been developed to meet the needs of pregnant women's skin. The second part of this work with 2 clinical studies conducted has demonstrated its efficacy on both the prevention and correction of stretch marks and validated the general appreciation of this product.

5. Conclusion

Applying multiple noninvasive methods allow a global view and understanding of the skin during pregnancy. Cosmetic skin care may have a positive impact on skin during pregnancy and in the postpartum period.

References

[1] B. Heidemann et al. Changes in maternal physiology during pregnancy. Br J Anaesth. 2003;3:65-68.1 .
[2] G. Boyer et al. Effects of pregnancy on skin properties: A biomechanical approach. Skin Res Technol. 2018 Nov; 24(4):551-556.
[3] G. Stamatas t al. Biophysical properties of striae distensae evaluated in vivo using non-invasive assays. Skin Res Technol. 2015;21:254-258.
[4] F. Henry et al. Striae distensae of pregnancy. An in vivo biomechanical evaluation. Int J Dermatol. 1997;36:506-508.