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# The influence of UV-A laser radiation upon the cancer markers TPS and CA15-3

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Our study deals with a lot of more than 50 patients with breast cancer disease and is lasting by more than two years. The values of the antigens CA15-3 and TPS were recorded both before and after the exposure of the human serum to ultra-short UV-A laser pulses. Our conclusion is that the number of pulses does influence the TPS values while the CA15-3 seams to be more robust and stable. The temporal distribution of UV energy is an important control parameter. The results are compared with those of a healthy sample. The pulse energy is correlated with the determinations. Our study is important for designing a novel monitoring scheme for patients subjected to crossing type laboratory analyses.

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*Keywords*: Breast cancer, Human serum, Ultra-short UV laser pulses, Antigens

## 1. Introduction

Breast cancer is the most common life-threatening malignant lesion in women of many developed countries today, with approximately 180,000 new cases diagnosed every year. Roughly half of these newly diagnosed patients are node-negative, however 30% of these cases progress to metastatic disease. Various methods and schemes of paraclinical diagnoses or cross correlated analyses [1,2] were developed in last years in order to detect early-stage cancer diseases. The specificity and robustness of these methods are of great interest in order to increase the accuracy and to lower the costs of the tests. Much effort and great resources are allocated to novel types of laboratory analyses and medical equipment, as well as for binary bio-chemical substances.

There are a number of tumor markers that can help clinicians to identify and diagnose which breast cancer patients will have aggressive disease and which will have an indolent course. These markers include estrogen and progesterone receptors, DNA ploidy and percent-S phase profile, epidermal growth factor receptor, HER-2/neu oncogene, p53 tumor suppressor gene, cathepsin D, proliferation markers and CA15-3. While the tissue polypeptide specific antigen (TPS) is a tumor marker that indicates tumor proliferative rate rather than tumor burden, CA15-3 is a glycoprotein which is most useful for monitoring patients post-operatively for recurrence, particularly metastatic diseases.

## 2. Samples and instruments

The marker levels TPS şi CA 15-3 were measured using the Immulite and Axsym methods and equipments in the clinical laboratory of the Oncologycal Institute „Al. Trestioreanu", Bucharest. The upper level of the normal values were 38U/ml and 80U/ml, respectively.

The serum samples from 56 pacients (women) with breast cancer were irradiated with the third harmonic (355 nm wavelength, max. 65 mJ/pulse, 5ns FWHM, repetition rate max. 10Hz) of a Nd-YAG „Brilliant" laser.

The fundamental and the second harmonics are rejected by spatial filtering. The energy per pulse was lowered to 5mJ and the beam intercepted the sample over the whole section of the order of 1cm$^2$. Thus, every laser pulse is delivering approximately the same energy deposited by the sun in every second and per every square centimeter in the UV-A range [3]. While the irradiation with more that 50 pulses revealed an almost constant response for all the samples, interesting changes were obtained for irradiation with small number of pulses, i.e. less than 10 pulses.

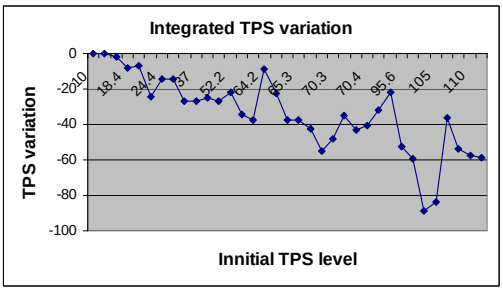


*Fig. 1. Integrated TPS variation vs. initial TPS level.*

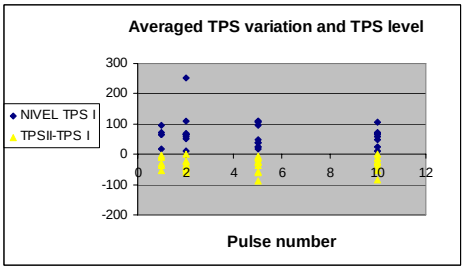


*Fig. 2. TPS variation vs. pulse number.*

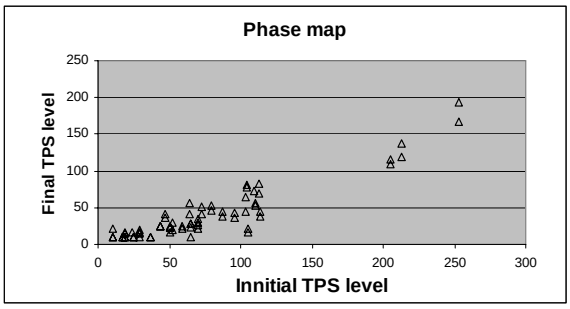


*Fig. 3. Final TPS level vs. initial TPS level.*

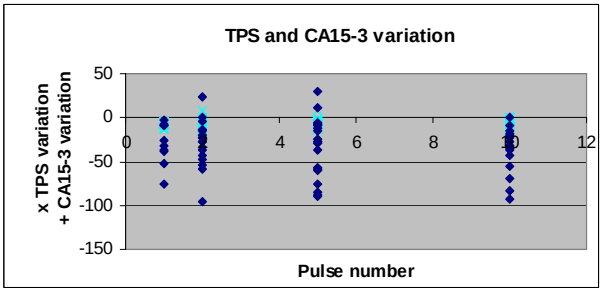


*Fig. 4. TPS variation compared with CA15-3 variation vs. pulse number.*

## 3. Results

In Fig. 1 there is not shown explicitly the number of irradiation pulses. The integrated picture exhibits a decaying trend. The greater the initial level, the greater the variation (decrease in more than 80% cases), and the greater the fluctuations. In Fig. 2 there is not shown explicitly the initial TPS level. Five pulses seem to be a "saturation" threshold since the envelope of the TPS variation is reaching the plateau. In Fig. 3 the greater the initial TPS level, the greater also its final value. Since both axes are linearly represented, one concludes that the two quantities are following also a linear dependence. However, this assumption is suffering significant deviations in the range 40U/ml – 120U/ml i.e. at the useful values of the marker. In Fig. 4 CA15-3 is robust against UV irradiation since its variation are as mach as the fluctuations induced by the measuring errors. TPS is a different case.

## 4. Discussion

CA15-3 variation is not significant and, at least under our assumptions and working conditions, the analysis seems to be very robust. The case of TPS is very different. Its value reduces for a larger number of pulses in most cases, excepting several samples. Moreover, the greater the initial value, the greater the changes.

For the same averaged energy, the ultra short, ultra-intense laser pulses have by far a greater influence. In fact, no influence is detected when exposed in the day light for eight hours. The thermal effects are negligible since the average temperature change is less than 0.5K for every irradiation cycle

## 5. Conclusions

The 355 nm-UV radiation strongly influences the level of one cancer markers, namely TPS. As stated in literature, besides the breast cancer, it is used for pancreas [4] and uterus cancer monitoring. The presence of UV-A radiation in the solar light is weak and does not influence the TPS level in the collected serum, but sample manipulation close to the UV lamps, including the common mercury lamps for local illumination or sterilization, i.e. intense UV sources, might cause serious artifacts.

**Acknowledgement**

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## References

[1] Sjöström J.; Alfthan H.; Joensuu H.; Stenman U.-H.; Lundin J.; Blomqvist C., "Serum tumour markers CA 15-3, TPA, TPS, hCGβ and TATI in the monitoring of chemotherapy response in metastatic breast cancer", Scand. Journ. of Clin. and Lab. Inv., **61**, (6), pp. 431-441(11), 2001.

[2] Mihaela Scarlat, F. Radu, Aurora Tache, Laura Radu, Andreea Tache, "Importanta determinarii *CA 15-3* concomitent cu *CEA* si *TPS* in monitorizarea pacientelor cu neoplasm mamar", A IV-a Conf. a Fundatiei de Laborator Clinic "Marcela Zmfirescu Gheorghiu", Oradea, 2005.

[3] Balasaraswathy P, Kumar Udaya, Srinivas CR, Nair Shashidharan, "UVA and UVB in sunlight, Optimal Utilization of UV rays in Sunlight for phototherapy", Ind. Journ. of Dermat. and Venerol.and Leprol., **68**, (4), 198-201**,** 2002.

[4] Slesak B**,** Harlozinska-Szmyrka A**,** Knast W**,** Sedlaczek P**,** Einarsson R**,** van Dalen A**.,** **"**TPS and CA 19-9 measurements in the follow-up of patients with pancreatic cancer and chronic pancreatitis", Int J Biol Markers. Apr-Jun;19(2):115-9, 2004.

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