untreated BSM, was still a better inhibitor than fetuin for fractions agglutinating VCN-treated horse RBC suggesting that the terminal oligosaccharide SA-α-2-6-GalNAc, abundant in BSM, is preferred to SA-α-2-3(6)-Gal present in fetuin and thyroglobulin. However, since free GalNaC inhibited those lectin fractions it is possible that subterminal GalNAc, exposed by cleavage of sialic acid, was responsible for the inhibitory capabilities of asialo-BSM. The fraction agglutinating human RBC appears to recognize both structures to the same degree. Purification and physicochemical characterization of these lectin fractions now in progress in our laboratory, might confirm some of our tentative conclusions and elucidate possible relationships between specificity and molecular structure.

Although they present minor differences in their agglutination, crossed absorption and agglutination-inhibition profiles, the members of the family *Vaejovidae* studied so far (*Paruroctonus mesaensis, Vaejovis confuscius* and *V. spinigerus*), exhibit serum lectins which bind sialic acids. These profiles are different from the ones observed in the two members, of the Buthidae[3,4] examined in this respect, which, in addition to sialoconjugate-binding lectins also exhibit lectins specific for galactosyl residues. Since sialic acids are a late development in evolution[16], clues about the biological function(s) of chelicerate sialic acid-binding serum lectins might be found in the binding to KDO, uronic acids and N-acylaminosugars, all substances found in bacterial cell walls. These observations suggest that chelicerate serum lectins might be involved in defense functions against bacterial infection.

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Prolongation of the survival of skin grafts in mice by PUVA treatment

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Summary. The combined application of psoralen and UVA radiation to skin grafts induced a prolongation of the survival time of the grafts in mice. This was observed using the H-Y barrier, an allogeneic barrier without H-2 disparities, and a strong H-2 incompatible barrier. The effect is probably due to a reduction of antigen-presenting cells, or to other, unknown mechanisms.

During recent years, the so called PUVA therapy (psoralen + UVA irradiation) became popular in the treatment of psoriasis. It was shown that ultraviolet radiation (UVR) has a profound influence on the immune system, especially on antigen-presenting cells like Langerhans cells in the skin or dendritic and interdigitating cells in lymphoid organs. Thereby UVR often induces suppressor T cells and a suppression of immune reactions like contact hypersensitivity or tumor immunity. These questions have been reviewed recently[1-4]. Here we describe experiments to prolong the survival of skin grafts in mice by treatment of the grafts with 8-methoxy-psoralen (8-MOP) and longwave ultraviolet (UVA) irradiation.

Materials and methods. Mice of the strains AB/Bln, BALB/c, DBA/2 Bln, and C57Bl/6 Bln from the breeding colony of the Academy of Sciences of the GDR were used. 8-MOP was purchased from GEROT Pharmaceutica Vienna as a 0.15% solution (Oxsoralen®).

The tails of the donors were smeared twice with a mixture of equal parts of Oxsoralen® and glycerine. After 1 h the donors were anesthetised with 0.2–0.3 ml of a 1.4% solution of hexobarbital sodium salt and irradiated under fluorescent UV lamps (VEB NARVA Brand-Erbisdorf, 20 W, 220 V) that emit mainly UVA light (7% UVB) with an intensity of 2.25×10^{-3} J/cm^2 × sec at a distance of 10 cm. Therefore, the UVR doses were 4.05, 8.10, 16.2, and 32.4 J/cm^2, respectively.

Then small epidermal grafts were excised with a blade and transplanted to similarly prepared skin sites on the recipient's tail. Each recipient received 2 grafts which were covered with a glass tube fixed on the distal end of the tail. The grafts were checked daily for viability using a stereomicroscope. A full rejection was recorded for 1 individual when it had rejected both grafts. For statistical evaluation the nonparametric Wilcoxon Mann-Whitney test was used.

Results. Transplantation against a H-Y barrier: Male donor mice of the inbred strain AB were treated with 8-MOP, the grafts were irradiated in situ with UVR and transplanted to female recipients of the same strain. The results are shown in table 1. They show a remarkable dose-dependent prolongative effect of the PUVA treatment.

Transplantation against an allogeneic barrier without H-2 disparities: Similar experiments were performed using female DBA/2 mice as donors and female BALB/c recipients (both H-2^d). The results are shown in table 2. The mean survival time (MST) showed that also in this system there was a clear-cut dose-dependent prolongative effect of the PUVA treatment on graft survival.

Transplantation against a strong H-2 incompatible barrier: Here, we studied the effect of PUVA treatment in a strong allogeneic barrier, representing a full house mismatch in all transplantation loci. As donors we used C57Bl/6 mice (H-2^b),

Table 1. Prolongation of skin graft survival in the combination AB (♂) →AB (♀) by PUVA treatment

Group	UV dose (J/cm²)	MST[a] (days)	n	p <
1	0	19.1 ± 2.18	10	–
2	4.05	52.9 ± 21.80	10	0.0010
3	8.10	69.8 ± 21.40	12	0.0005
4	8.10[b]	70.6 ± 18.31	9	0.0010

[a] MST mean survival time, $\bar{x} \pm SD$; [b] The tails of the donor mice were smeared with 8-MOP and irradiated with 8.10 J/cm² UVA on days −6, −4, and 0; the transplantations were performed on day 0.

and as recipients BALB/c mice (H-2^d). The results are shown in table 3. UV radiation alone has no effect on graft rejection (group 5, table 3). Again, PUVA treatment prolonged the MST of the grafts. UVA without application of 8-MOP did not prolong the survival of the grafts (group 5, table 3), but 8-MOP without UVA (group 6, table 3) undoubtedly prolonged graft survival, but not so much as PUVA treatment. This could be due to a so-called dark effect of 8-MOP as described by Lischka and Decker[1], or due to irradiation by visible light stemming from the laboratory illumination with daylight-type fluorescent bulbs.

Discussion. The results presented show that in mice, a combined treatment of grafts in situ with psoralen and UV radiation prolongs the mean survival time of the grafts in the presence of weak and of strong histocompatibility barriers. Similar results were achieved by Morison et al.[2]. They transplanted skin from 8-MOP and UVA treated rabbits to similarly treated recipients and found a certain prolongation of graft survival (MST of the controls 8.7 days, of PUVA treated rabbits 13.I days), but their studies were not performed in a defined inbred system.

Streilein et al.[3] transplanted UVB irradiated trunk skin of mice in H-2 K, D or Ia congeneic strain combinations but they could not achieve any prolongation of MST by this means. PUVA treatment may therefore be the best known method of graft prolongation by UVR. We also transplanted PUVA treated allogeneic skin to PUVA treated recipients (intraperitoneally given 8-MOP plus UVA on the shaved backs), but the MST in these experiments was not greater than in those where PUVA treated skin was grafted to untreated recipients (unpublished results). Currently we are trying to improve our methods to achieve a systemic alteration by PUVA treatment.

About the mechanism by which PUVA prolongs the survival of allografts only hypothetical explanations can be offered. In several trials it was shown that UVB as well as PUVA can interfere with the function of Ia bearing antigen-presenting cells[3–5]. In the skin grafts used these may be epidermal Langerhans cells or dermal dendritic cells. Langerhans cells can present antigens to responding lymphocytes [6–8] and stimulate the MLR [9,10]; both functions are diminished by UVB[7–9]. UVB[11–15], or PUVA treatment[13,16,17] of skin leads to drastic alterations in the morphology and surface markers of epidermal Langerhans cells. Recently we observed disturbed ATPase reactivity of Langerhans cells in PUVA treated mouse tail skin (unpublished results).

Dendritic cells have been found not only in lymphoid organs[18,19] but also in the connective tissue of many organs[20]. They effectively present antigens[21,22] and stimulate the MLR[23,24]; both functions are sensitive to UVB[25] or PUVA[26]. It may be that PUVA inhibits antigen-presenting cells in the graft, which leads to decreased alloimmunogenicity. UVR can also influence the function of macrophages[27], viability and mitogen response of lymphocytes[28] or generation of effector lymphocytes[29]. Up to now we are not able to give a more definite explanation for the observed prolongation of skin graft survival by PUVA treatment.

Table 2. Prolongation of skin graft survival in the combination DBA/2 → BALB/c by PUVA treatment

Group	UV dose (J/cm²)	MST (days)	n	p <
1	0	29.6 ± 3.11	11	–
2	4.05	33.8 ± 3.50	4	0.010
3	8.10	42.4 ± 4.17	8	0.001
4	16.20	45.1 ± 3.26	9	0.001
5	32.40	41.3 ± 5.72	6	0.005

Table 3. Prolongation of skin graft survival in the combination C57Bl/6 → BALB/c by PUVA treatment

Group	UV dose (J/cm²)	MST (days)	n	p <
1	0	12.1 ± 1.38	14	–
2	4.05	18.6 ± 4.24	14	0.0001
3	8.10	15.2 ± 3.40	14	0.0002
4	16.20	16.8 ± 2.64	9	0.0050
5[a]	32.40	12.6 ± 1.90	10	NS[c]
6[b]	0	14.1 ± 1.60	10	0.0050

[a] Without 8-MOP (control); [b] 8-MOP only (control); [c] NS not significant.

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