THE EFFECT OF CUCUMBER (*CUCUMBIS SAVITUS*) EXTRACT ON ACID INDUCED CORNEAL BURN IN GUINEA PIGS

BY

UZODIKE*, E. B. AND ONUOHA, I. N.

DEPARTMENT OF OPTOMETRY, ABIA STATE UNIVERSITY,
UTURU, ABIA STATE
EMAIL: ebeluzo@yahoo.com
*Corresponding author

ABSTRACT

Cucumber is the edible fruit of the cucumber plant, Cucumis Sativus. Cucumber is used for skin treatment and natural beautification. It is called a cool fruit which effect is believed to bring relief to the eyes in summer. Thirty six guinea pigs between ages 17-20weeks and weight 0.4-0.7kg had their cornea induced with acid burn wound using 0.1M of hydrochloric acid. The animals were then divided into four groups of 9 animals. The groups were CB group treated with cucumber bark extract only, CP group treated with cucumber pulp extract only, CB+CP group treated with cucumber bark and pulp extract and the control group that received no treatment. Stock extracts were used in the three groups; no dilution of any kind was employed. The regimen used was 2 drops of their drug, 3 times daily till healing occured The acid wounds were stained with flourescein and the size measured with PD rule before commencement of the treatment on the first day of the experiment and daily till the wound healed. At the end of the study, the CB+CP group had the shortest healing period (17days with healing rate of 0.92mm^2), followed by CB group (19days with healing rate of 0.90mm^2), the CP group (26 days with healing rate of 0.80mm^2) and lastly the control group (30days with healing rate of 0.70mm^2). Statistical analysis using students to T-test (two-tailed) showed that the rates of healing between the treated groups and the control group were statistically significant (P>0.05). Cucumber extract when pharmacologically refined could be incorporated in first aid treatment of corneal acid burn.

KEYWORDS: *Cucumber extract, corneal acid burn, guinea pigs, alpha hydroxyl acids, beta hydroxyl acids.*

INTRODUCTION

Cucumber is a creeping vine that roots in the ground and grows up other supporting frames, wrapping around ribbing with thin, spiraling tendrils. The plant has large leaves that form a canopy over the fruit. The fruit is roughly cylindrical, elongated, with tapered ends, and may be as large as 60 cm long and 10 cm in diameter. Cucumbers are mainly eaten in the unripe green form. The ripe yellow form normally becomes too bitter and sour[1].

Cucumber is the edible fruit of the cucumber plant *Cucumis Sativus. Cucumis Sativus* belongs to the gourd family cucurbitaceous[2]. Its plant is a warm season annual plant cultivated for its fleshly fruit, eaten as a salad vegetable or used for pickling[3]. It produces stiff hairs on the leaves and stems which can be rather itchy and irritating to human skin when touched. The branching stem of the cucumber plant attains a length of 12 to 18 feet[4]. There are basically two types of cucumber - the pickling variety and the slicing variety. Of these, the pickling variety is relatively small, around 2-4 inches long. Cucumber has been considered as one of the oldest cultivated vegetables on earth[5]. Its cultivation in western Asia dates to at least 3,000 years[6]. Cucumbers are believed to have originated in Southern Asia[4].

Popularly used for skin treatments and for natural beautification, cucumber has various benefits associated with it - right from skin to body and overall health. It is a nutritious and a naturally cool fruit. Cucumbers have cooling properties and are extremely good for bringing relief to the eyes in summers[7]. The fruit has the highest water content of any vegetable, about 96% water[5]. Other than its use as a salad vegetable, cucumber fruit extracts are often incorporated as a primary ingredient in many topical skin preparations. Its deep cleansing action stems from its natural chemical constituent of glycolic, lactic and salicylic acids. These acids are known as organic or fruit acids because they contain one or more carboxyl radicals (COOH) in their structure[8]. Cucumber seeds possess similar properties to those of the allied Pumpkin (*Cucurbita Pepo*) which are distinctly diuretic, but mainly employed as a very efficient taeniacide and can be used as an emetic substance[7].

As a cosmetic, cucumber is excellent for rubbing over the skin to keep it soft and white. It is cooling, healing and soothing to an irritated skin, whether caused by sun, or the effects of a cutaneous eruption. Cucumber soap is used by many women, and a cucumber wash applied to the skin after exposure to keen winds is extremely beneficial. It is used in preparation of glycerin and cucumber cream. Cucumber has use in perfume production. It is an invaluable fruit for prevention and treatment of various problems associated with liver, kidney, stomach, ulcer, arthritis and gout[7]. Major constituents of cucumber are lactic acid, glycolic acid and salicylic acid. Lactic and glycolic acid belong to a subdivision known as alpha hydroxyl acids while salicylic acid belongs to beta hydroxyl acid[9]. Another constituent of cucumber is ascorbic acid[2] and 14a-methyl D-phytosterol (phytosterols)[10].

Alpha hydroxyl acids have been used as chemical exfoliants to promote the natural removal of dead cells and to keep the protective surface layers healthy by dissolving the glue like substance in the epidermal layer that cause a build up of dead skin cell layer; leaving skin dehydrated, dull and coarse. Histologically, alpha hydroxy acids have been shown to increase the thickness of the epidermis as well as cause increased collagen density, improved elastic fiber quality, increased papillary dermal thickness and increased dermal acid mucopolysacharide translating into thicker, healthier skin with fewer rhytids[11,12,13]. Alpha hydroxyl acids have been effective in the treatment of many skin conditions such as ache, psoriasis, bumps, pustules, eczema, dry skin, age spots, seborrheic keratosis, precancerous growths, hyperkeratosis, actinic keratosis and also black heads and whiteheads[14].

Glycolic acid is the most active and beneficial of the alphahydroxyl acids in skin care, because of its ability to penerate through the cell wall by virtue of its small molecular size[15]. Once inside the cell, it triggers new formation of collagen and turns on the synthesis of dermal glycosaminoglycans to plump up the cell and the ground substance in the skin to reduce wrinkles on the skin's surface[9]. Lactic acid improves the appearance of photodamage and surface pigmentation[16]. Salicylic acid, a component of aspirin (acetyl salicylic acid) is a keratolytic agent, an antiseptic and a fungicide[17,18]. It can be used for the treatment of hyperkeratotic and scaling conditions such as dandruff, ichthyosis and psoriaisis[19]. It also possesses fungicidal properties and is used topically in the treatment of fungal skin infections such as tinea[20].

Phytosterols include plant sterols and stanols. Plant sterols are naturally occurring substances present in the diet principally as minor components of vegetables oils. Phytosterols are effective in lowering plasma total and low density lipoprotein (LDL) cholesterol and this occurs by inhibiting the absorption of cholesterol from the small intestine[21]. Recent studies[19,23] have shown this sterol to be effective in slowing down prostate cancer growth in mice. It also has the ability to reduce inflammations in patients with autoimmune diseases such as rheumatoid arthritis and lupus and also accelerates the occlusion of wounds and prevents heart diseases. It has been shown to improve the control of blood sugar among diabetics[24]. Ascorbic acid protects against bacterial infections such as bacterial pharyngitis and tonsillitis, heart diseases, arthritis, allergies and also against viral infections[25]. This vitamin helps in the maintenance of the strength of the walls of the blood capillaries, also in the development and maintenance of healthy bone, teeth and gums. It acts as an antioxidant[25].

Corneal acid burns are caused when acidic chemicals come in contact with the cornea. They are usually less serious than those caused by alkaline, because acids tend to precipitate tissue proteins which coagulate and form a barrier thus preventing deep penetration[26]. The main damage is therefore restricted to the lids, conjunctiva and cornea[27]. According to Vaughan, et al[26], all chemical burns must be treated as ophthalmic emergencies. First immediate treatment is a copious irrigation of the ocular surface, including the conjunctival fornices with a sterile isotonic saline. The severity of damage to ocular structures should also be assessed using a slit lamp biomicroscope or a penlight and flourescein staining.

RESEARCH METHODOLOGY

This study was designed to determine if topically applied cucumber extract has any healing ability on acid induced corneal burn. It was a prospective, case-controlled and laboratory based one. The experimental animals used were guinea pigs. The research was conducted at the Department of Zoology, Imo State University.

The animals used in this study were 36 guinea pigs, with age range of 17-20 weeks and weight range of 0.4-0.7kg. They were obtained from a guinea pig farm in Jos, Plateau State and certified

to be healthy by a renowned veterinary doctor. There were four study groups with six guinea pigs in each group. The study groups comprised the untreated (control) group and groups treated with extracts of cucumber bark only (CB group), cucumber pulp only (CP group) and cucumber bark and pulp (CB+CP group).

A set of fresh cucumber fruits was washed with salt solution and rinsed with water. The barks or skins were peeled and the peeled cucumbers cut into small chunks which were blended with a blender until fine pulp was obtained. Thereafter, cucumber pulp juice was extracted. The peeled skins or barks were cut into sizeable chunks and blended with a blender until fine pulp was also obtained. The juice of the cucumber bark was then extracted. Another set of cucumber was washed with salt solution and rinsed with clean water; they were cut into small chunks for blending. The juice of the cucumber pulp and bark was also extracted.

The animals were allowed 7days of food and water *ad libido* to acclimatize before burn was induced on the 1st day of the experiment. This was done by first anaesthetizing the right eye of each guinea pig with one drop of lignocain hydrochloride thereafter; the burn was induced using a swab stick dipped in 0.1M of hydrochloric acid and placed on the cornea of the animals for 30 seconds to allow just enough damage. In conformation with the management procedure for acid burns[26], the eyes of the animals were immediately copiously irrigated with normal saline solution to prevent further damage to other ocular structures.

Treatment commenced on the same day of injury by instilling drops of cucumber bark extract (CB group), cucumber pulp extract (CP group) and cucumber pulp and bark extract (CB+CP group) on the right eye of the animals receiving treatment. The control group however was left untreated. Prior to subsequent treatment, the eyes of the guinea pigs were rinsed with normal saline three times daily to guard against infection. The control group also received saline rinsing. Each guinea pig of the respective group was administered two drops of their extract three times daily until healing occurred.

The area of abnormal cornea was ascertained daily by staining with fluorescein dye. The stained area was then observed using a pen touch and a +10.00D lens and the denuded area measured with a P.D rule. The area of the wound was determined by the shape of the wound. For circular wounds, area was determined using πr^2, for rectangular or square shape wounds, area was calculated as L x B and for triangular shaped wound, area was calculated as ½ B x H. Where π ($^{22}/_{7}$) is a constant, r is radius, L is the length, B is the breath and H is the height.

Healing is directly proportional to reduction in wound size. As the wound size is decreased, it signifies healing was in progress. Therefore, any decrease in the size of wound measures the efficacy of the treatment.

RESULTS

The immediate effects produced by the acid burn in the eyes of the guinea pigs included; slight hyperemia, lid edema and conjunctival hemorrhage. The changes in the behavioral pattern of the animals were the squinting of the right eye in response to pain and a reduced eating rate. However, the behavioral changes and signs of burn lasted for only few hours. The sizes of the wounds were measured and area calculated on daily basis for each animal and the average used for the group. Graphs, regression coefficient and student's T statistics were used to analyze the results.

Findings from this study showed that healing of the acid burn corneas took place within 30days. The group treated with CB+CP extract had the shortest healing time of 17days followed by group treated with CB extract with a healing time of 19days, the group treated with CP extract with a healing time of 26days and control group with the least healing time of 30days (fig.1). The rate of healing was found to be 0.90mm^2, 0.80mm^2, 0.92mm^2 and 0.70mm^2 per day for CB, CP, CB+CP and control groups respectively. Also the time for partial healing (when half the mean wound size has healed) was found to be 11days, 14days, 9days and 17days respectively.

Regression analysis result was found to be -0.91, -0.74 and -0.99 for CB, CP and CB+CP groups respectively. T-calculated (-2.250, -2.124 and -2.567 for treatment groups respectively) was found to found to lie outside t-tabulated (±1.734) showing that the difference in wound healing between the treated groups and the control group was statistically significant (P>0.05).

DISCUSSION

Complete healing of the acid induced wound occurred on the 17th day in CB+CP group, 19th day in the CB group, 26th day in the CP group and 30th day in the control group (see fig. 1). The calculated rates of healing for the CB, CP, CB+CP and Control groups were 0.90mm^2/day, 0.80mm^2/day,

0.92mm^2/day and 0.70mm^2/day respectively. From the statistical analysis, the values of the regression analysis were found to be -0.91, -0.74, and -0.99 for the treatment groups respectively. The time of partial healing for the CB, CP, CB+CP and control groups were also deduced to be 11days, 14days, 9days and 17days respectively. It therefore showed that the CB+CP group had the shortest time for partial healing followed by the CB group, the CP group and lastly the control group.

The above findings were not surprising as cucumber has been reported to have healing effects on cutaneous eruption[7], hence on epithelial cells of cornea which were affected by the acid burn. This healing effect of cucumber on the epithelial cells (skin), the researchers believed is due mainly to alpha hydroxyl acids (lactic and glycolic acids) and ascorbic acid constituent of cucumber[9]. A difference was noticed between the healing rates of wounds in the CB and CP groups. Complete healing of the acid wound was noticed on the CB group on the 19th day of treatment while on the CP group, it was noticed on the 26th day of treatment. The USDA National Nutrient Database for standard Reference[28] shows that there are minute differences in the nutrient value for peeled and unpeeled cucumber. The unpeeled cucumber showed greater nutrient value than the peeled. The peeled has a lower content of vitamin C; folate and vitamin A than the unpeeled cucumber. This may account for the difference in the rates of healing of wounds between the two treated groups.

Test for significance using t-distribution, showed that the difference in rate of healing between treated groups and control group was statistically significant. Cucumber extract has been reported to be used in skin treatment and that it brings cooling effects to the eyes in summer[7]. Hence the result of this study is in consonance with other research findings. Cucumber juice extract is recommended as part of first aid regimen in the treatment of acid burnt eyes especially where orthodox medicine is not readily available. Nonetheless, the researchers are calling for further and indepth research on this topic in terms of topical preparation, concentration and dosage.

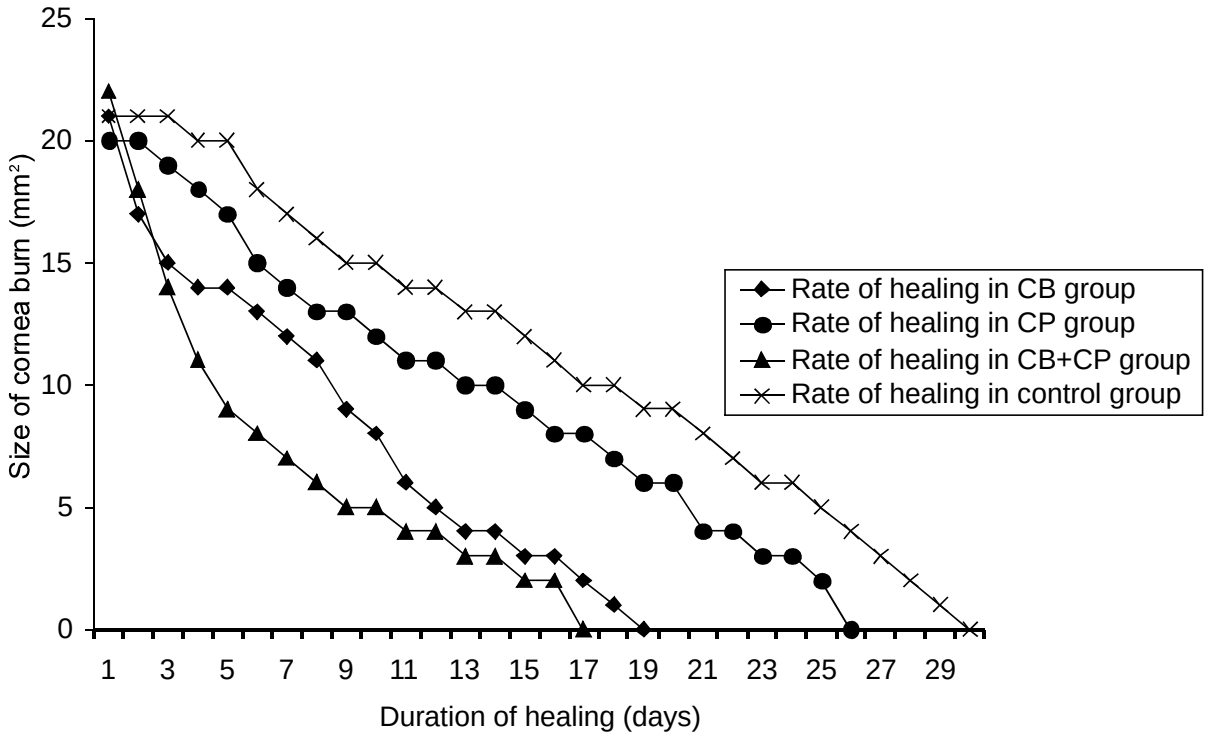

Fig. 1: Period of healing of the acid induced cornea burn

REFERENCES

1. Doijode, S. D. (2001): *Seed storage of horticultural crops*. 1st Edn. Haworth Press, 339pp.
2. Tindall, H.D. (1975): Vegetables in the tropics. The Macmillian Press Publications, London, pp159-61.
3. The Encyclopedia Americana, International Edition, (1980): 30th Edn. Grolier Inc, London, pp 309-10.
4. Tindall, H. D. (1968): Commercial vegetable growing. Oxford University Press Publications, London, pp147-50.
5. Simons, A. J. (1976): The New Vegetable Grower's Handbook. Perguim Books Ltd, Middlesex, pp166-7.
6. McCollum, E. (1980): Vegetables in the Tropics. 2nd Edn. Perguim Book Ltd, Middlesex, pp127-9.
7. Mateljan, G. (2006): The World's healthiest foods-essential guide for the healthiest way of eating. 1st Edn. World's Healthiest Foods, 880pp.
8. McGraw Hill Dictionary of Chemistry (1984): 3rd Edn. McGraw Hill Book Co. New York, 223pp.
9. Brannon, H. (2002): Treating wrinkles with alpha hydroxy acid. Dermatol, Surg. 33: 120-42.
10. Pollak, O.J. (1953): Successful prevention of experimental hypercholesterolemia and cholesterol arteriosclerosis in rabbits. Circulation. 12:696 701.
11. Moy, L.S., Howe, R. and Moy, R.L. (1996): Glycolic acid modulation of collagen production in human skin fibroblast cultures in vitro. Dermatol. Surg. 22 (5): 439-41.
12. Bernstein, E. F., Lee, J., Brown, D. B., Yu, R. and Vanscott, E. (2001): Glycolic acid treatment increases type 1 collagen mRNA and hyaluronic acid content of human skin. Dermatol. Surg. 27(50): 429-33.
13. Kim, S.J., Park, J.H., Kim, D.H., Won, Y.H. and Maiback, H. I. (1998): Increased in vivo collagen synthesis and in vitro cell proliferative effect of glycolic acid. Dermatol. Surg. 24 (10); 1054-8.
14. Swanbeck, G. (1968): A new treatment of Ichthyosis and other hyperkeratotic conditions. Acta Derm. Venereol (Stockh) 48:123-7.
15. Schupack, J. L., Haber, R. S. and Stiller, M. Y. (1990): The future of topical therapy for cutenous aging. J. Dermatol. Surg. & Oncol, 16:941-4.
16. Kordel, L. (1976): Lelord kordel's natural folk remedies. Manton Press Ltd, London, pp177-84.
17. Stedman's Medical Dictionary (1990): 27th Edn. Lipincott William and Wilkins, Maryland, 1588pp.
18. Katzung, B.G. (2001): Basic and Clinical Pharmacology. 8th Edn. McGrawHill Co, New York, 1058pp.
19. Quilliot, D., Bomam, F., Creton, C., Pelletier, X., Floquet, J. and Debry, G. (2001): Phytosterols have an unfavorable effect on bacterial activity and no evident protective effect on colon carcinogenesis. Euro. J. Can. Preven, 10(3): 237-43.
20. Reynold, J.E.F. (1996): Salicylic acid in: Martindale The extra pharmacopoeia. 31st Edn. The Royal Pharmaceutical Society, London, 1093pp.
21. Nguyen. T.T. (2001): The cholesterol lowering action of plant stanolesters. J. Nutr, 129: 2109-12.
23. Awad, A. (1999): Phytosterol from plant sources like peanut, slow prostate cancer growth in mice. Euro. J. Cancer Pre. 22 (2): 5-10.
24. Lee, Y. M., Haastert, B. and Scherbaum, W. (2003): A phytosterol-enriched spread improves the lipid profile of subjects with type2 diabetes mellitus; a randomized control trial under free-living condition. Euro. J. Nutri, 42:111-7.
25. Zhang, H.M. (1999): Vitamin C inhibits the growth of a bacterial risk factor for gastric carcinoma-Helicobacter pylori: Cancer 19:122- 34.
26. Vaughan D., Asbury, T. and Riodan-Eva, P. (1999): General Ophthalmology. 5th Edn. McGraw Hill Co. New York, pp351-2.
27. Kanksi, J. J. (1998): Clinical Ophthalmology: A system approach. 3rd Edn. Butterworth Heinemann, Oxford, pp89-90.
28. The USDA National Database for standard Reference (1999).