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The Effect of Aloe Vera Juice on Planarian
Regeneration Time

Animal Sciences

Any Grade 7-12

Center City MS/HS

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Abstract

The juice from Aloe Vera plants has been used for thousands of years to promote wound healing. It is difficult to test wound healing on human beings, but Planaria worms can be used to model wound healing. Can Aloe Vera juice promote wound healing in Planaria worms by decreasing regeneration times? The hypothesis is that various concentrations of Aloe Vera juice will decrease the regeneration time of Planaria worms.

Procedure: Four Aloe Vera solutions were used: Control=Water, 1%, 5% and 10%. 30 mL of the solutions were poured into 3 Petri dishes = total of 12 = 1 trial. 3 trials were done. Planaria worms were cut in two parts and 3 tails were placed into each Petri dish. Planaria were checked at 3:00pm to determine when they were fully regenerated. A fully regenerated Planarian had to show a complete head with eyespots and 'earflaps.'

Results: Not all the worms survived in each trial. The highest percentage of survivors was 1% and 5%, followed by Control, followed by 10%.

- The average number of days it took for the Control worms to regenerate was the baseline for comparison of regeneration times.
- Control (Spring Water) was 14.6 days.
- 1% Aloe Vera = 14 days = 4% faster than Control.
- 5% Aloe Vera = 13 days = 12% faster than Control.
- 10% Aloe Vera = 13.6 days = 7% faster than Control

Conclusion: It was predicted that Aloe Vera Juice would decrease the regeneration time of Planaria. Based on the results, all three percentages of Aloe Vera Juice—1%, 5%, and 10%-- decreased the regeneration time of the Planaria compared to the 14.6 day control. Since all factors in the experiment were kept the same except for the percentage of Aloe Vera juice, it can be concluded that Aloe Vera Juice decreased the regeneration time for Planaria worms. The regeneration time was not dependent on the % of Aloe Vera. The 10% regeneration time was slower than 5% but faster than 1%. Rank order of regeneration- 5%→10%→1%→Control.

Survivors: Aloe Vera had a slight positive effect on Planaria survival at 1% and 5%, but had a negative effect on survival at 10%, perhaps because Aloe Vera was hurting cell function at that concentration. Rank order of survival = 1%+5%→Control→10%

The optimal concentration of Aloe Vera to promote Planaria regeneration and survival = 5%.

Background Information

- *Aloe Vera* is a succulent which grows wild in tropical climates around the world and is used as a decoration and for medicinal purposes. Its leaves are thick and fleshy and possess short, sharp spikes along the edges. It contains chemicals that may have antibacterial and anti-inflammatory properties. Aloe Vera may speed healing by improving blood flow to an injured area, improving collagen formation, or keeping the wound moist. Glucomannan contained in Aloe Vera stimulates the growth of fibroblasts which build new collagen.
- Planarian worms (phylum Platyhelminthes, class Turbellaria) are free-living and are found throughout the world. They are scavengers and can be captured in ponds and streams using liver. Planarians have one opening for eating and removing waste. They take in oxygen through their skins through diffusion. One of the most apparent features of Planarians is their eyespots. They can detect light and will move away from it. They are well known for their ability to regenerate after being cut into parts and are much used in biological and biomedical research, including research on aging and stem cells. Planarians have been sent to the International Space Station, where they also regenerated.

Problem- Will Juice from an Aloe Vera plant decrease the regeneration time of Planaria?

Hypothesis- Aloe Vera juice will decrease the regeneration time in Planaria.

(Alternative: If Planaria are regenerated in Aloe Vera Juice, then their regeneration time will be reduced.)

Materials: 150 Planaria worms, 48 glass Petri dishes, 10 mL graduated cylinder, 500 mL graduated cylinder, spring water, razor blades, beef liver, 3 Aloe Vera plants, soil, water, plastic wrap, eye dropper



Brown Planarian

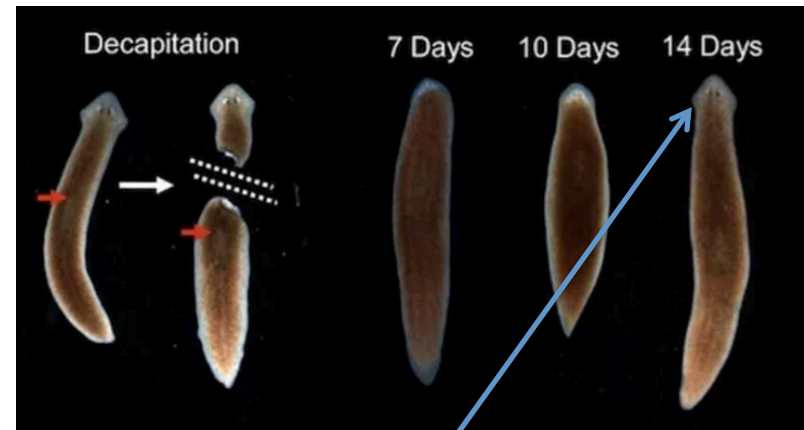
Planarian Flatworm. Credit: Tufts University



Aloe Vera Credit: Homeremedies.com

Procedure

- 150 Brown Planaria were ordered from Carolina Biological to ensure 108 viable, healthy worms.
- The Planaria were placed in an aerated, shallow aquarium with Spring Water and fed beef liver for a week before the experiment.
- Three Aloe Vera plants of the same species were purchased from Home Depot, and kept under grow lights in the classroom. All conditions for the plants were maintained the same, including the temperature at 23 °C.
- A different plant was used for each trial with random leaves being selected. Number of trials = 3. The 3 trials ran at the same time.
- Solutions were made 10 minutes before the experiment to ensure the Aloe Vera juice was fresh. Making the Solutions:
 - Control= Spring Water- Arrowhead to maintain proper osmolarity.
 - a. 1% Stock Solution: 3 mL of fresh Aloe Vera gel extracted from a leaf mixed with 297 mL of Spring Water
 - b. 5% Stock Solution: 15 mL of fresh Aloe Vera gel extracted from a leaf mixed with 285 mL of Spring Water.
 - c. 10% Stock Solution: 30 of fresh Aloe Vera Gel extracted from a leaf mixed with 270 mL of Spring Water.
- 30 mL of the Spring Water (Control) were placed into 3 different Petri Dishes. (See diagram on next page.)
- 30 mL of the 1% Aloe Vera solution were placed into 3 different Petri dishes. 30 mL of 5% Aloe Vera solution were placed into 3 different Petri dishes. 30 mL of 10% Aloe Vera solution were placed into 3 different Petri dishes. (See diagram on next page.)
- Planaria worms were randomly taken out of the aquarium, placed on an ice cube, and cut in two equal parts using a razor blade.
 - The head parts were immediately returned to the aquarium to regenerate.
 - 3 tails were placed into each Petri dish listed above to be used in the experiment.
- The Planaria were checked once a day at the same time (3:00pm) to see when they were fully regenerated. A fully regenerated Planarian had to show a complete head with eyespots and 'earflaps'
- Fully regenerated worms were counted, removed and placed in the aquarium.
- Data were recorded until all the worms regenerated= 17 days.



Complete head with eyespots and 'earflaps'

3 Tails
Spring Water-
Control

3 Tails
Spring Water-
Control

3 Tails
Spring Water-
Control

Procedure (cont'd)

= CONTROL X 3 TRIALS

3 Tails
1% Aloe Vera
Solution

3 Tails
1% Aloe Vera
Solution

3 Tails
1% Aloe Vera
Solution

3 Tails
5% Aloe Vera
Solution

3 Tails
5% Aloe Vera
Solution

3 Tails
5% Aloe Vera
Solution*

3 Tails
10% Aloe Vera
Solution

3 Tails
10% Aloe Vera
Solution

3 Tails
10% Aloe Vera
Solution

=EXPERIMENTAL X 3
TRIALS

Results

Results of Trials

Results: A planarian was considered completely regenerated when the head, eyespots and ear “flaps” were complete.

Compiled Results:

1. The number of regenerated worms for each day was added up.
2. The number of each worms regenerated on a day was multiplied by the day and added.
3. The average was found by dividing the sum by the total number of survivors.

TRIAL 1		Days to Regeneration					
Aloe Vera %	12	13	14	15	16	17	Number of Worms
0 (C)	0	1	4	2	1	1	
1	0	2	5	1	0	0	
5	1	3	5	0	0	0	
10	1	2	4	0	0	0	

TRIAL 2		Days to Regeneration					
Aloe Vera %	12	13	14	15	16	17	Number of Worms
0 (C)	0	1	2	3	1	0	
1	0	2	2	3	1	0	
5	2	3	2	0	0	0	
10	0	2	2	2	0	0	

Trial 3		Days to Regeneration					
Aloe Vera %	12	13	14	15	16	17	Number of Worms
0 (C)	0	1	3	2	1	0	
1	1	1	4	2	0	0	
5	3	4	1	0	0	0	
10	1	2	2	1	0	0	

Compiled Results

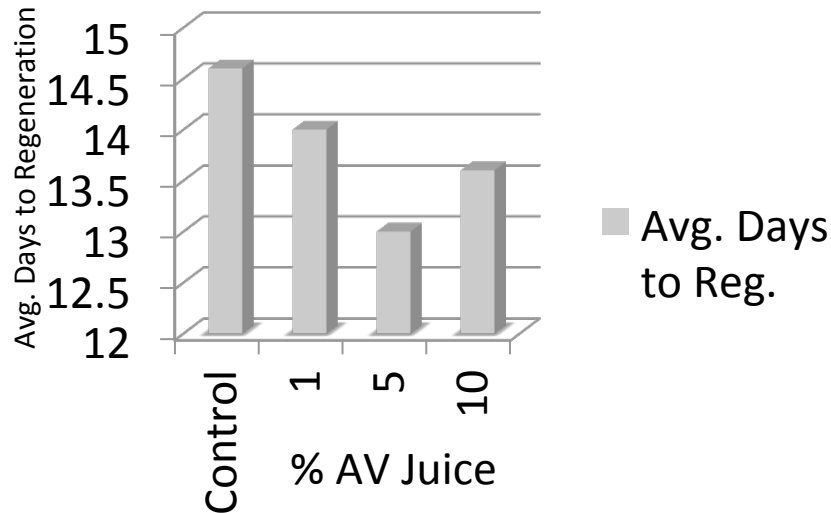
	Days to Regeneration							
Aloe Vera %	12	13	14	15	16	17	Avg. days to Reg.	% Survival
Control	0	3	9	7	3	1	14.6	85
1	1	5	11	6	1		14	89
5	6	10	8				13	89
10	2	6	8	3			13.6	70

Number of Regenerated Planarian Worms

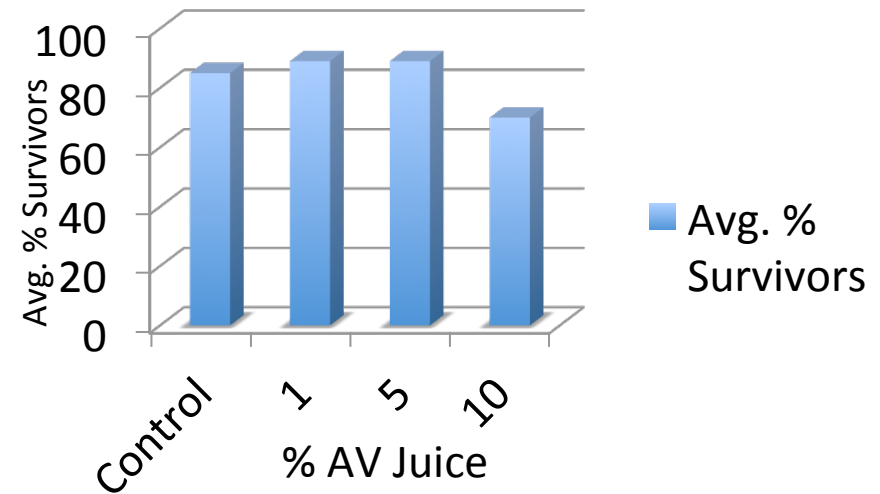
Avg. Days to Regeneration and % Survival

Aloe Vera %	Avg. days to Reg.	% Survival
Control	14.6	85
1	14	89
5	13	89
10	13.6	70

Avg. Days to Reg.



Avg. % Survivors



Summary of Results:

Not all the worms survived in each trial. The highest percentage of survivors was 1% and 5%, followed by Control, followed by 10%.

The average number of days it took for the Control worms to regenerate was the baseline for comparison of regeneration times.

The average number of days to regeneration in the:

Control (Spring Water) was 14.6 days.

1% Aloe Vera solution was 14 days = 4% faster than Control. $|14-14.6|/14.6 = .04 \times 100 = 4\%$

5% Aloe Vera solution was 13 days = 12% faster than Control. $|13-14.6|/14.6 = .12 \times 100 = 12\%$

10% Aloe Vera solution was 13.6 days = 7% faster than Control. $|13.6-14.6|/14.6 = .07 \times 100 = 7\%$

Conclusion

In the hypothesis it was predicted that Aloe Vera Juice would decrease the regeneration time of Planaria. Based on the results, all three percentages of Aloe Vera Juice—1%, 5%, and 10%-- decreased the regeneration time of the Planaria compared to the 14 day control, with 5% having the quickest regeneration time, followed by 10%, then 1%. Since all factors in the experiment were kept the same except for the percentage of Aloe Vera juice, it can be concluded that Aloe Vera Juice decreased the regeneration time for Planaria worms. The regeneration time was not dependent on the % of Aloe Vera. The 10% regeneration time was slower than 5% but faster than 1%. Rank order of regeneration- 5%→10%→1%→Control.

Survivors: Aloe Vera had a slight positive effect on Planaria survival at 1% and 5% compared to Control, but had a negative effect on survival at 10%, perhaps because Aloe Vera was hurting cell function at that concentration. Rank order of survival = 1%+5%→Control→10%

The optimal concentration of Aloe Vera to promote regeneration and survival = 5%.

References

1. Advanced Tissue. "Is Aloe Vera Effective in Wound Care?" www.advancedtissue.com August 8, 2016 <https://www.advancedtissue.com/alo-vera-effective-wound-care/>
2. Agata, Kiyokazu and Kenji Watanabe. "Molecular and Cellular Aspects of Planarian Regeneration." *Seminars in Cell & Developmental Biology*. Volume 10, Issue 4, August 1999, pp. 377-383.
3. Aloe vera. January 9, 2018. https://en.wikipedia.org/wiki/Aloe_vera
4. Berkeley Wellness. "Does Aloe Vera Work?" www.berkeleywellness.com June 10, 2015. University of California Berkeley <http://www.berkeleywellness.com/self-care/home-remedies/over-the-counter-products/article/does-alo-vera-work>
5. Muskopf, Shannan. "What is a planarian?" www.biologycorner.com 2017. Biology Corner <https://www.biologycorner.com/worksheets/articles/planarian.html>
6. Pant, Anupum. "Planarian Worm—Cloning was never this easy." awesci.com WESCI Science Everyday <http://awesci.com/planarian-worm-cloning-a-creature-was-never-this-easy/>
7. Planarian. October 25, 2017. <https://en.wikipedia.org/wiki/Planarian>
8. Raffa, Robert B. and Scott M. Rawls. *Planaria: A Model for Drug Action and Abuse*. London: Taylor & Francis Ltd., 2008. pp. 34-37.
9. Sharma, Anoop. "Aloe Vera Benefits, Uses, and Pictures." www.homeremedies.com August 23, 2016. <http://www.homeremedies.com/alo-vera-benefits-uses-and-pictures/>
10. Smithers, Mark. "Automated Experiments on Worms help understand human mind." www.rdmag.com August 15, 2016. <https://www.rdmag.com/article/2016/07/automated-experiments-worms-help-understand-human-mind>
picture credit: Tufts University