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Original Research Article

EVALUATION OF THERAPEUTIC EFFICACY OF ALOE VERA GEL FOR EXCISIONAL WOUND HEALING MECHANISM USING ANIMAL MODEL

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Abstract *association with obesity, diabetes mellitus, and high blood pressure conditions. Various therapeutic options were available for the wound-repairing process. The current study project evaluated the healing properties of Aloe Vera gel on epidermal wounds in rats. Experimental animals (adult rats) were divided into groups A, B, and C with equal distribution. These groups represent treatment, without treatment, and control, respectively. A pair of wounds measuring 2cm x 2cm each was created hygienically on the back of each rat lateral to the spinal cord. The wounds were treated with homogenized Aloe Vera gel, while the injuries in the second group were treated with normal saline. Blood samples were collected on days 21 for hematology analysis with a standard method. Animals in group 'A' had significantly faster healing with shorter days of skin fall-off than the control and untreated group. Further biochemical changes in the packed cell volume, mean corpuscular volume, lymphocyte and neutrophil counts also showed significant results compared to the control group. The study concluded that Aloe Vera effectively treated epidermal wounds in adult rat models. An improvement occurred in the hematological profile of the experimental animals. These findings will go a long way in expanding the horizon of the clinical application of this plant in solving wound-healing problems in humans and other animal species.*

Keywords: *Aloe Vera* gel, Epidermal wounds, Hematology, clinical application

Introduction

A wound is a damage to the skin or loss of continuity of epithelium, with or without loss of underlying connective tissues. Different causative agents include injury to the skin, surgery, a burn, cut, chemicals, heat, cold, friction, shear force, pressure or diseases such as leg ulcers or carcinomas (Wilkins *et al*., 2013). Wound healing is the mechanism of recovery of damage skin and soft tissues after injuries. It's a complex series involved diverse signalling molecules and proteins (Lin *et al*., 2015). From ancient ages, natural plant extracts and herbs have been commonly applied as diseases cure options worldwide. Due to the unavailability of modern medication facilities and poor economic status, 80-85% of the human population is still attached to this traditional medicinal power of natural plants and plant extracts. Among them *Aloe Vera* gel and extract of honey comb (honey) discovered the wonderful power of wound healing process (Jamil et al., 2020).

Various pharmaceutical herbs used as curative measures now-a-days needed further inclination for the identification of undiscovered constituents (Reina *et al.*, 2013). Since antiquated times required for wound healing, exceptionally intricate procedures have been utilized (Chithra et al., 1998; Deng et al., 2015). On wound healing different investigations have been done, consequently various substances have been introduced that frequently here and their connections, ones which are home grown mixes (Wang et al., 2000; Adzick, 1996; Zeng et al., 2017 and Chen et al., 2015). Applications of compound formula remedies of natural extracts also limit the time required for healing. Most commonly considered prescriptions are pharmaceutical herbs (Chatterjee et al., 2013). In any case, as a compelling prescription till now, none of them can be offered. The impacts of chemical substances for example, phenition, salt serum, Vitamin A, growth factors, hydrocortisone, and Ascorbic Acid, as certain models can be referenced (Chen et al., 2012). It is picking up prominence in dentistry as it is common, and no reactions are accounted for with its utilization

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(Salcido, 2014). Aloe Vera plant has a special place in the liliacece family and currently identified 360 species (Ahlawat and Khatkar, 2011). It is a standard, drought spell, sticky plant. The unique property of the plant is its high moisture content ranging from 99-99.5%. The aloe name starts from the Arabic "Alloeh" or Hebrew "Halal" signifies seriously shiny master (Atul, 2011). One Aloe Vera type is *Aloe barbadensis* Miller, which has significant values in Central Asia, Europe (Ahluwaliaa et al., 2016).

Generally, it is applied on the skin as a balm to treat wounds. It is a moist plant broadly used in different medicine. The lower leaf of the plant is utilized for therapeutic reason. The green color of the leaf can be made into a juice that contains vitamin A (Roy et al., 2012). In a few investigations, the antigen's toxic and chemopreventive impacts highlighted its anti-oxidative effects (Reina et al., 2013). Aloe Vera plant comprises various proteins with catalytic effects, including Brady kinase and carboxypeptidase, which regulate analgesic and anti-inflammatory responses in living cells. It also contains diverse polysaccharides, notably pectic acid or glucomannans, which have wound-healing properties, immuno-stimulatory, antimicrobial, and antioxidative activities. Therefore, it has wide applications for therapeutic purposes (Jamil et al., 2020). Aloe Vera gel is produced in the focal point of the Aloe Vera leaf using its adhesive tissue. (Borra et al., 2011). Aloe gel comprises polysaccharides, sugars, minerals, amino acids, fatty acids, and phenolic compounds. The major components of bitter yellow latex are anthraquinones and glycosides (Bhattarai, 2017). More than 240 bioactive substances with diverse therapeutic characteristics were recognized in plant leaves (Singh et al. 2019). The topical application of Aloe Vera gel may also stimulate angiogenesis and increase wound's blood supply, thus better fulfilling its metabolic requirements (Soliman, 2015). On the opposite side, certain side effects include hypokalemia, diarrhea, pseudo melanosis coli, nephrotoxicity, hepatotoxicity, and phototoxicity and hypersensitive reactions after oral Aloe preparations (Guo, 2016). Moreover, the whole leaf extract of Aloe Vera induces carcinogenicity in rats. Hence it was classified as a possible carcinogen for humans by the international agency for cancer research (Grosse et al., 2013; Cancer, 2015). The main objective of the current study was to evaluate the wound-healing effects of Aloe Vera plant gel by checking different biochemical parameters in the animal model.

2.0 Materials and Methods

2.1 The research project was undertaken at animal house of Institute of Molecular Biology and Biotechnology (IMBB) and Diagnostic lab The University of Lahore, Pakistan.

2.2 Collection of Aloe Vera gel extract

Aloe Vera plant was collected from PCSIR Society Lahore. Then gel extract was obtained by peeling fresh leaves. Potential therapeutic effects of Aloe Vera gel extract were studied in the excisional cutaneous wound healing mechanism of Sprague dawley rats.

2.3 Experimental animals and their maintenance

The male adult rats were placed in the Institute of molecular biology and Biotechnology (IMBB) departmental animal house at 26±20 ∘C

2.4 Inclusion criteria

Young male rats with weights of (160 to 200) gm. were selected for the current study.

2.5 Exclusion criteria

Female rats were excluded due to breeding problem. Obese and underweight rats (150) gm were excluded to minimize variations among the animal models. Under or average rats were also excluded for the sake of consistency.

2.6 Study design

Twelve (12) Sprague dawley rats were recruited through inclusion and exclusion criteria for present study. These were properly distributed into three groups comprising four (4) rats. As showing in the following table number 2.1.

Table 2.1: study design

Group	Characteristics	Number
A	Control	4
B	Experimental group (On treatment)	4
C	Experimental group (Without treatment)	4

Fig 2.1 Experimental animals (Sprague dawley rats)

2.7 Preparation of experimental animal

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The excisional cutaneous wounds were created by surgical knife in groups B and C, respectively.

2.8 Dose calculation & application of treatment

Group B rats were treated with 125mg raw extract of Aloe Vera gel water as a dose, while animals of group A and group C were not received any treatment.

2.9 Sample collection

After 24 days of treatment, rats were anesthetized by using chloroform. Later their blood samples were collected from the heart of rats by cardiac puncturing with 5 ml syringe after these rats were dissected. Blood samples were shifted into two different types of properly labeled vacutainers, one with EDTA use for complete blood analysis and the second without EDTA use for serum extraction.

2.10 Biochemical analysis

2.10.1 Complete blood count

All tests were performed on the 100 Japan hematology analyzers with their stromatolyser and cell pack to assess blood count.

2.10.2 Estimation of connective tissue (Hydroxyproline (HPR)

Using standard spectrophotometric analysis, samples were estimated at 540nm for Hydroxyproline levels.

2.10.3 Estimation of catalases

Catalase enzyme catalyzed the decomposition of H_2O_2 to give H_2O and O_2. The UV absorbance of H_2O_2 can be measured at 240nm. After completion of the reaction with standard reagent, absorbance was taken at 530 nm after150ul of the mixture was added in a micro-titer plat.

Statistical Analysis Data obtained from different biochemical parameters was analyzed by student t-test and represented in the form of means where the significant difference occurred.

3. Results

The present study project was led to assess the impact of Aloe Vera extract (gel) on excisional cutaneous wounds in experimental animals. Biochemical analysis and connective tissue status were checked. Obtained results are presented in the following table.

Table 3.1: Estimation of Hydroxyproline in experimental animal models

Sr.no	Group A*		Group B*		Group C*	
	1	2	1	2	1	2
1.	0.875(ng/ml)	0.966(ng/ml)	0.560(ng/ml)	0.465(ng/ml)	0.520(ng/ml)	0.345(ng/ml)
2.	0.879(ng/ml)	0.968(ng/ml)	0.565(ng/ml)	0.464(ng/ml)	0.521(ng/ml)	0.344(ng/ml)
3.	0.877(ng/ml)	0.967(ng/ml)	0.566 (ng/ml)	0.466(ng/ml)	0.521(ng/ml)	0.343(ng/ml)
	0.877	0.967	0.563	0.463	0.520	0.341
Mean±SD	0.922 ± 0.049		0.795±0.118		0.465±0.065	

Footnote :(*Group A: Control, Group B: Excisional wound with treatment, Group C: Excisional wound without treatment)

Findings for hydroxyproline (HRP) levels of Groups (A, B, and C) were recorded as (0.922), (0.795), and (0.465), respectively. A significant level of hydroxyproline was observed in Group A as compared to Group B and Group C. While Group B showed a greater level than Group C but low in comparison to Group A, as represented in Figure 3.1

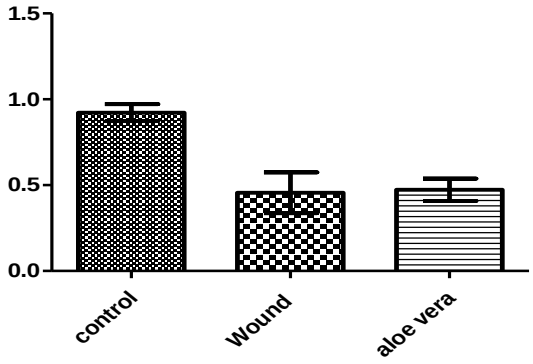

Fig 3.1 Graphical representation of hydroxyproline levels in different groups of experimental animals

Table 3.2: Estimation of catalase (enzyme) in experimental animal models

Sr.no	Group A		Group B		Group C	
	1	2	1	2	1	2
1.	0.9624	1.5368	1.5368	1.6772	1.3757	1.5997

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2.	0.8751	1.3682	1.7124	1.8671	1.3682	1.5346
3.	0.8130	0.8505	1.6696	1.8637	0.8505	0.9963
	0.8835	1.2518	1.5859	1.8026	1.2518	1.4395
Mean ± SD	1.0676 ±0.306		1.6127±0.283		1.497±0.383	

Footnote :(*Group A: Control, Group B: Excisional wound with treatment, Group C: Excisional wound without treatment)

In the present study catalase levels in Group A, B, C were recorded as (1.0676), (1.6127), and (1.497). Compared to Group A and Group C, there were increased results in Group B. While Group C increased from Group A but was low compared to Group B.

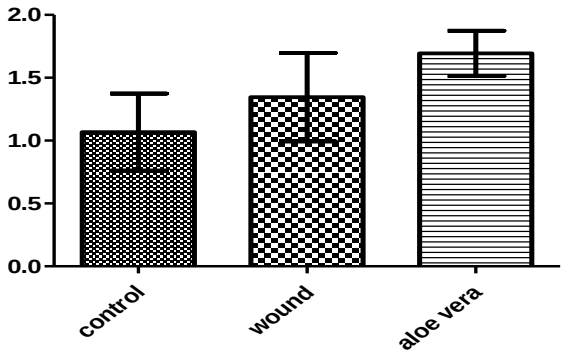

Fig 3.2 Graphical representation of Catalase levels in different groups of experimental animals

Table 3.3 White blood cells (WBC) of experimental animal models

(N) Sample size	Group A	Group B	Group C
1.	9.0	7.8	18.6
2.	11.8	12.4	20.7
Mean ± SD	10.4±1.979	10.6±3.252	19.1±1.484

Footnote :(*Group A: Control, Group B: Excisional wound with treatment, Group C: Excisional wound without treatment)

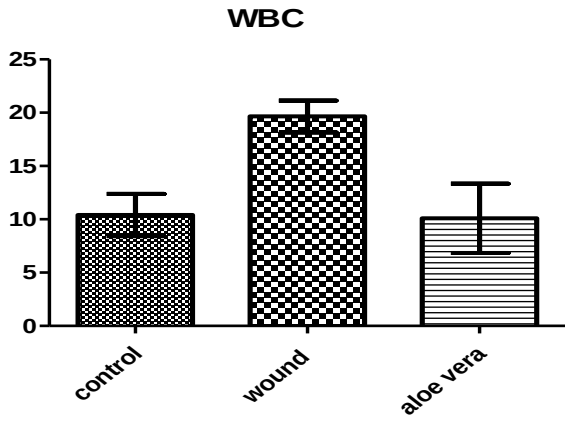

Fig 3.3 Graphical representation of WBC (White Blood Cells) in different groups of experimental animals

Table 3.4 Red blood cells (RBC) of experimental animal models

(N) Sample size	Group A	Group B	Group C
1.	7.54	9.96	9.25
2.	7.81	7.83	6.74
Mean ± SD	7.67±0.190	8.89±1.50	7.99±1.77

Footnote :(*Group A: Control, Group B: Excisional wound with treatment, Group C: Excisional wound without treatment)

The results of Red blood cells (RBC) of Group A, B, C were recorded as (7.67), (8.89) and (7.99) Increased result significantly was observed in Group B as compared to group A and C.

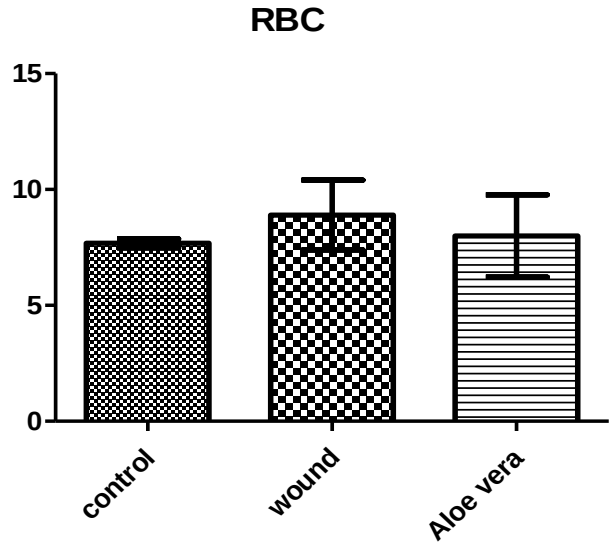

Fig 3.4 Graphical representation of RBC (Red Blood Cells) in different groups of experimental animals

Table 3.5 Hemoglobin (HGB) of experimental animal models.

(N) Sample size	Group A	Group B	Group C
1.	14.4	15.7	13.7
2.	14.2	18.1	14.0
Mean ± SD	14.3±0.141	16.05±2.033	14.7±1.89

Hemoglobin (HGB) levels of Group A, B, C were recorded as (14.3), (16.05), and (14.7). The highly increased result was observed in Group B compared

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to Group A and C. While group B showed an increase from group C but low compared to group B.

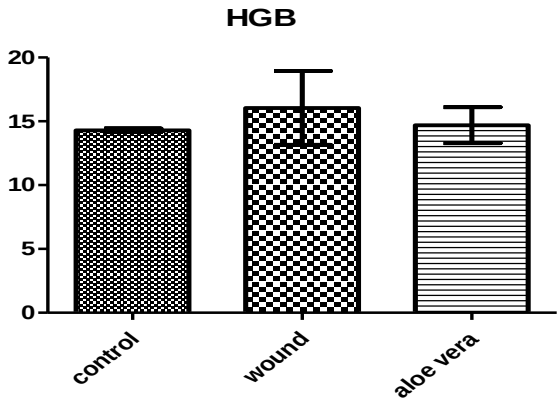

Fig 3.5 Graphical representation of Haemoglobin (HGB) in different groups of experimental animals

4. Discussion

This study was planned to investigate the activity of Aloe Vera gel extracts on the different biochemical parameters involved in the wound healing process in male albino rats. The findings of the present project related to Aloe Vera gel action on wound cure indicated an improved rate of wound healing in Sprague Dawley rats by shorter days of healing compared to previous literature review reports. In this case, the old skin from the injured area was removed within 9 days compared to the control (mean 12 days), which took 12 days. THE PRO-HEALING INGREDIENTS ARE vitamin C, amino acids, vitamin E, and zinc. The presence of these constituents is reported in the literature in this plant.

Wound treatment in Sprague dawley rats with Aloe Vera gel significantly affected wound healing, especially during the phases of wound repairing, which are proliferative and maturation. In Aloe Vera certain components, such as flavonoids and Saponins having wonderful healing properties (Borra et al., 2011). After the final experimental period (24 days) different hematological and biochemical parameters, including Catalase enzyme, HRP, WBC, RBC, and Hemoglobin of all experimental groups were measured. The recent study observed that the hydroxyproline concentration significantly differed among all groups of rats. It was noticed that group B (treatment with aloe Vera) depicted an increased level compared to group C, while lower with the control group (Table 2.1). The results are similar to the previous research data, where more levels of HRP facilitate the wound healing mechanism (Chithra et al., 1998). Aloe Vera has been utilized as a purgative since old occasions, dermatologic conditions, and the treatment of numerous disarranges, including diseases, it is assessed by the influence of Aloe Vera gel on dermal wound healing. The significant organization of gel twice daily quickens dermal wound healing in rodents. It accelerates wound healing in animals, due to the presence of phytochemicals. Also, interacting with the growth factor receptors, which in turn stimulated a growth hormone present in the gel could have partly played important roles in faster wound healing by glucomannans, a mannose-rich polysaccharide, and gibberellin, the activity and proliferation of fibroblasts and promoted collagen synthesis similar to earlier reports.

5. CONCLUSION

The current study concluded that Aloe Vera gel positively affected wound healing mechanisms. Significant clinical applications of this medicinal plant as a cure option for the solution of wound repair in both animals and human beings were reported. Hematology in the experimental treated and untreated animal groups showed significantly changed results. To further investigate with a point of view to discovering more uses of aloe Vera plant in the animal species and human apart from its wound healing effects.

Declarations

Conflict of interest

The authors have no conflict of interest.

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Funding

Not applicable

References

Agarwal PK., A. Singh, K. Gaurav, S. Goel, H. D. Khanna, and R. K. Goel. (2009) Evaluation of wound healing activity of extracts of plantain banana (*Musa sapientum* var. *paradisiaca*) in rats, *Indian Journal of Experimental Biology* **47**(1):32-40.

Boudreau M. and F.A Beland. (2006). An evaluation of the biological and toxicological properties

of Aloe Barbadensis (Miller), Aloe vera. *J. Environ. Sci.Health C. Environ. Carcinog. Ecotoxicol. Rev* **1**(24):103–154.

Chithra, G.B Sajithlal and G. Chandrakasan. (1998). Influence of Aloe vera on collagen Characteristics in healing dermal wounds in rats. *Mol. Cell Biochem,* **1**(181):71–76.

Chen, T., Wu, Q., Zhou, H., Deng, K., Wang, X., Meng, F., ... & Wei, H. (2017). Assessment of commercial probiotic products in China for labelling accuracy and probiotic characterisation of selected isolates. *International Journal of Dairy Technology*, ***70***(1), 119-126.

[Citation Perveen, A., Abbas, S., Khan, S.U., Mazhar, M., Fiaz, A. (2023). Evaluation of therapeutic efficacy of aloe vera gel for excisional wound healing mechanism using animal model. *Biol. Clin. Sci. Res. J.*, **2023***:340.* doi: https://doi.org/10.54112/bcsrj.v2023i1.340]

Deng, K., Chen, T., Wu, Q., Xin, H., Wei, Q., Hu, P., ... & Shah, N. P. (2015). In vitro and in vivo examination of anticolonization of pathogens by Lactobacillus paracasei FJ861111. 1. *Journal of Dairy Science*, ***98***(10), 6759-6766.

Heggers, J. P., Kucukcelebi, A., Listengarten, D., Stabenau, J., Ko, F., Broemeling, L. D., ... & Winters, W. D. (1996). Beneficial effect of Aloe on wound healing in an excisional wound model. *The Journal of Alternative and Complementary Medicine*, ***2***(2), 271-277.

Hashemi, S. A., Madani, S. A., & Abediankenari, S. (2015). The review on properties of Aloe vera in healing of cutaneous wounds. *BioMed research international*, ***2015***. (1):1-6.

Gao, Y., Kuok, K. I., Jin, Y., & Wang, R. (2019). Biomedical applications of Aloe vera. *Critical reviews in food science and nutrition*, ***59***(sup1), S244-S256.

Lin, L., Wang, P., Wang, Y., Huang, Y., Jiang, L., & Wang, X. (2016). Aloe vera and Vitis vinifera improve wound healing in an in vivo rat burn wound model. *Molecular Medicine Reports*, **13**,1070-1076. https://doi.org/10.3892/mmr.2015.4681

Luzina IG, EM. Pickering, P. Kopach, PH. Kang, V. Lockatell, N. Todd et al., (2012)

Full- length IL-33 promotes inflammation but not Th2 response in vivo in an ST2-independent fashion. *Journal of Immunology* **1**(89):03-10.

Marcandetti M and AJ. Cohen., (2002) Wound Healing, Healing and repair. Last updated October-7-2002, eMedicine.com. lnc **3**(2):68-71.

Morton JJP and MH. Malone., (1972) Evaluation of vulnerary activity by open wound procedure in rats. *Arch Int Pharmacodyn* **1**(96):17-26.

Purohit, S. K., Solanki, R., Soni, M. K., & Mathur, V. (2012). Experimental evaluation of Aloe vera leaves pulp as topical medicament on wound healing. *International Journal of Pharmacological Research*, *2*(3), 21-25.

Patil PA and DR. Kulkarni., (1984). Effect of antiproliferative agents on healing of dead space wounds in rats. *Indian Journal of Medical Research* **79**(1):45-47.

Patil S., (2009) Evaluation of healing activity of marketed formulations on excision wounds models in Albino rats. *Int J Pharm Tech Res* **1**(3): 500-501.

Pandey M., (2012) Comparison of wound healing activity of Jethimadh with Triphala in rats. *Int J Health & Allied Sciences* **1**(2): 59-63.

Saini, Sapna, Anju Dhiman and Sanju Nanda. (2016). Traditional Indian medicinal plants with potential wound healing activity: a review. *International Journal of Pharmaceutical Sciences and Research* 7(5):136-138.

Salcido R., (2014) Fruits, berries and nuts: phytochemicals in wound healing. *Advances in skin*

and wound care. **27**(7):296.

Sabale, P., Bhimani, B., Prajapati, C., & Sabalea, V. (2012). An overview of medicinal plants as wound healers. *Journal of Applied Pharmaceutical Science*, ***2***(11), 143-150.

Pravin, S., Kale, M. K., Mahendra, G., Nikhil, A., & Pathak, A. K. (2011). Evaluation of wound healing activity of Arisaema leschenaultii Blume. In rats. *Der Pharmacia Lettre*, ***3***(4), 200-206.

Sari, Y., Purnawan, I., Kurniawan, D. W., & Sutrisna, E. (2018). A comparative study of the effects of Nigella sativa oil gel and Aloe vera gel on wound healing in diabetic rats. *Journal of evidence-based integrative medicine*, ***23***, 2515690X18772804.

Udupa, S. L., Udupa, A. L., & Kulkarni, D. R. (1994). Studies on the anti-inflammatory and wound healing properties of Moringa oleifera and Aegle marmelos. *Fitoterapia*, ***65***(2), 119-123.

Wilkins, R. G., & Unverdorben, M. (2013). Wound cleaning and wound healing: a concise review. *Advances in skin & wound care*, ***26***(4), 160-163.

Wang, X., Wu, Q., Deng, K., Wei, Q., Hu, P., He, J., ... & Chen, T. (2015). A novel method for screening of potential probiotics for high adhesion capability. *Journal of Dairy Science*, ***98***(7), 4310-4317.

[Citation Perveen, A., Abbas, S., Khan, S.U., Mazhar, M., Fiaz, A. (2023). Evaluation of therapeutic efficacy of aloe vera gel for excisional wound healing mechanism using animal model. *Biol. Clin. Sci. Res. J.*, **2023***:340.* doi: https://doi.org/10.54112/bcsrj.v2023i1.340]