Volume 7, No. 2, March 2017 * Bimonthly

ISSN: 2251-9939

Journal of Life Science and Biomedicine

Available online at www.jlsb.science-line.com

Published by
Scienceline Publications

Journal of Life Science and Biomedicine

(2251-9939)

J. Life Sci. Biomed. 7 (2): 13-25, March 25, 2017

Join JLSB Team

Journal of Life Sciences and Biomedicine (JLSB) as international journal is always striving to add diversity to our editorial board and operations staff. Applicants who have previous experience relevant to the position they are applying for may be considered for more senior positions (Section Editor) within JLSB. All other members must begin as Deputy Section Editors before progressing on to more senior roles. Editor and editorial board members do not receive any remuneration. These positions are voluntary.

If you are currently an undergraduate, M.Sc. or Ph.D. student at university and interested in working for JLSB, please fill out the application form below. Once your filled application form is submitted, the board will review your credentials and notify you within a week of an opportunity to membership in editorial board.

If you are PhD, assistant, associate editors, distinguished professor, scholars or publisher of a reputed university, please rank the mentioned positions in order of your preference. Please send us a copy of your resume (CV) or your ORCID ID or briefly discuss any leadership positions and other experiences you have had that are relevant to applied Medical and Pharmaceutical Researches or publications. This includes courses you have taken, editing, publishing, web design, layout design, and event planning. If you would like to represent the JLSB at your university, join our volunteer staff today! JLSB representatives assist students at their university to submit their work to the JLSB. You can also, registered as a member of JLSB for subsequent contacts by email and or invitation for a honorary reviewing articles.

Contact us at: editors@jlsb.science-line.com

Download Application Form (.doc)

Archive

Volume 7 (2); March 25, 2017

Research Paper

Optimization of Cellulase Production by *Aspergillus niger* and *Trichoderma viride* trough Water Hyacinth (*Eichornia crassipes*) as Substrate.


Figure 1. SSF Fermentation Figure 2. Crude Enzyme Figure 3. Enzyme Assay

Elwin, Kusnadi J, Hendrawan Y, Yudiana I-M.
J. Life Sci. Biomed., 7(2): 13-18, 2017;
pii:S225199391700003-7

Abstract
Water hyacinth (*Eichornia crassipes*) is one of many raw materials that can be used to produce bioethanol as renewable energy. One of critical process to produce bioethanol from water hyacinth is hydrolysis in order to convert cellulose to be glucose. Hydrolysis process which uses commercial cellulase is very expensive so that the product of bioethanol can not be accepted economically. The objective of this research is to optimize the production of crude cellulase enzyme produced by *Aspergillus niger* and *Trichoderma viride* in process of bioethanol production trough water hyacinth. This research showed that the production of crude cellulase enzyme by *Aspergillus niger* is optimum on 8 days of incubation, temperature 34ºC and 8% of glucose concentration which obtain 5.84 U/g of Cellulase activity. In addition, the production of cride enzyme by *Trichoderma viride* is optimum on 6 days of incubation, temperature 30ºC and 8% of glucose concentration which obtain 4.41 U/g of Cellulase activity. *Aspergillus niger* obtained hihger sellulase activity compare to *Trichoderma viride*. So that for the next study cellulase enzyme can be produced by using *Aspergillus niger*. Cellulase activity in this research was crude enzyme, for further study the experiment should be conducted by using pure enzyme for better result.

Keywords: Cellulase, Optimization, *Aspergillus niger, Trichoderma viride*

[Full text-PDF] [XML]

Review

On the Physiology of Immune System

Kumar Pandey A, Pandey G and Pandey BL.
J. Life Sci. Biomed., 7(2): 19-25, 2017;
pii:S225199391700004-7

Abstract
The immune system distinctively has predominant concern of qualitative homeostasis. It serves housekeeper role for factors (majority of them, have endogenous origin) appearing as dangers for homeodynamics of the organism. Precisely, the immune system endeavors in dynamic optimal self maintenance within an organism which constantly faces varied infringements from the environment. Processes of growth, development and aging are all under supervision of immune system. The brain beholds perceptive topographic map of body architecture to both sense and issue actions in specified direction. The immune cells also behold broad image of the whole immunological self. By referring to this, the cells notice a danger molecule which is structurally non-conforming. This map is integrated with the antibody forming system or response forming system of these cells. Ability of immune system to detect unwelcome entries and then alert its various cell groups as well as the brain puts it at par with sensory organ. Classical features include active interactions with hypothalmo-pituitory-adrenal axis (HPA) or with autonomic nervous system mediated through specific peripheral and central cytokines. Immune system is committed to preservation of self by neutralizing dangers and keeps constancy and integrity of the organism. Immune response is evoked for restoring homeostasis consequent to damage. Secondly, interactions between activating and inhibiting mechanism of immune response needs to be optimally balanced.

Keywords: Hysiology, Immune system, Developmental biology, Neuroregulation

[Full text-PDF] [XML]

Archive

Journal of Life Science and Biomedicine

ISSN: 2251-9939

Frequency: Bimonthly

Current Issue: 2017, Vol: 7, Issue 2 (March)

Publisher: SCIENCELINE

The Journal of Life Science and Biomedicine is aimed to improve the quality and standard of life with emphasis on the related branches of science such as biology, physiology, biochemistry, zoology, anatomy, pathology and their applications and innovations in medicine and healthcare... view full aims and scope

http://jlsb.science-line.com

» JLSB indexed/covered by NLM Catalog, RICeST (ISC), Ulrich's™, SHERPA/RoMEO, Genamics, Google Scholar (h-index= 10), Index Copernicus, ICV2015: 66.26... details

» Open access full-text articles is available beginning with Volume 1, Issue 1.

» Full texts and XML articles are available in ISC-RICeST.

» This journal is in compliance with Budapest Open Access Initiative and International Committee of Medical Journal Editors' Recommendations.

ICMJE INTERNATIONAL COMMITTEE of MEDICAL JOURNAL EDITORS

» High visibility of articles over the internet.

» Publisher Item Identifier ...details

» This journal encourage the academic institutions in low-income countries to publish high quality scientific results, free of charges... view Review/Decisions/Processing/Policy

Editorial Offices:
Atatürk University, Erzurum 25100, Turkey
University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada
University of Maragheh, East Azerbaijan, Maragheh 55136, Iran
Homepage: www.science-line.com
Phone: +98 914 420 7713 (Iran); +90 538 770 8824 (Turkey); +1 204 8982464 (Canada)
Emails:
administrator@science-line.com
saeid.azar@atauni.edu.tr

Journal of Life Science and Biomedicine
J Life Sci Biomed, 7(2): 13-18, 2017

ISSN 2251-9939

Optimization of Cellulase Production by *Aspergillus niger* and *Trichoderma viride* trough Water Hyacinth (*Eichornia crassipes*) as Substrate

Elwin[1], Joni Kusnadi[1], Yusuf Hendrawan[1], I Made Yudiana[2]
[1] *Brawijaya University of Malang East Java, Indonesia*
[2] *Laboratorium of Biology Ecology of Indonesian Institute of Science, Bogor, Indonesia*

ABSTRACT

Water hyacinth (*Eichornia crassipes*) is one of many raw materials that can be used to produce bioethanol as renewable energy. One of critical process to produce bioethanol from water hyacinth is hydrolysis in order to convert cellulose to be glucose. Hydrolysis process which uses commercial cellulase is very expensive so that the product of bioethanol can not be accepted economically. The objective of this research is to optimize the production of crude cellulase enzyme produced by *Aspergillus niger* and *Trichoderma viride* in process of bioethanol production trough water hyacinth. This research showed that the production of crude cellulase enzyme by *Aspergillus niger* is optimum on 8 days of incubation, temperature 34°C and 8% of glucose concentration which obtain 5.84 U/g of Cellulase activity. In addition, the production of cride enzyme by *Trichoderma viride* is optimum on 6 days of incubation, temperature 30°C and 8% of glucose concentration which obtain 4.41 U/g of Cellulase activity. *Aspergillus niger* obtained hihger sellulase activity compare to *Trichoderma viride*. So that for the next study cellulase enzyme can be produced by using *Aspergillus niger*. Cellulase activity in this research was crude enzyme, for further study the experiment should be conducted by using pure enzyme for better result.

Original Article
PII: S225199391700002-7

Rec. 22 Nov. 2016
Acc. 10 Jan. 2017
Pub. 25 Jan. 2017

Keywords:
Cellulase, Optimization, *Aspergillus niger*, *Trichoderma viride*

INTRODUCTION

The need of energy is going to increase each year affect the decreasing of energy resources and creates it become expensive. Those because the resource of energy majorly from fossil energy which un-renewable and predicted will exhausted next 25 years [1, 2, 3]. Bioethanol is considered as alternative energy because it renewable and environment friendly [2, 4]. The production of bioethanol as alternative energy had been developed, but the production of bioethanol prior was not the solution because it used food-base material i.e. corn, seed and cassava [6, 8]. Water hyacinth (*Eichornia crassipes*) is one of non-food base material that can be used to produce bioethanol. It because water hyacinth contains cellulose (25%) that can be converted to be glucose which then can be used to produced bioethanol [2,4].

Hydrolysis in bioethanol production can be conducted by using cellulase enzyme [3, 5]. In the past process of cellulose hydrolysis in bioethanol production used commercial cellulase enzyme. The problem is cost of commercial enzyme is very expensive so that affect the bioethanol product trough water hyacinth cannot be accepted economically [2]. *Aspergillus niger* and *Trichoderma viride* had been reported as microorganisms that can produce cellulase enzyme [1]. Compare to other microorganism, *Aspergillus niger* and *Trichoderma viride* are better than other microorganism in producing cellulase enzyme. It due to the both fungus can produce three components of cellulase enzyme which are endoglukanase, eksoglucanase and glucosidase. So that this study is conducted to produce cellulase enzyme by *Aspergilus niger* and *Trichoderma viride* which will be used to hydrolyze cellulose on water hyacinth.

MATERIAL AND METHODS

Water hyacinth (*Eichornia crassipes*) was obtained from Selorejo bay, Malang district. Water hyacinth was separated from its root then washed with clean water to remove dirt and dash. Water hyacinth then was cut until it become ±2 cm in size. To decrease water content, water hyacinth was dried on oven temperature 100 ºC for 24 hours until the water content ±30%. After that water hyacinth was milled in disc mill and screened with 60 mesh of screener.

Aspergillus niger and *Trichoderma viride* was obtained from Indonesian Culture Collecton (InAcc) of Indonesian Institute of Science (LIPI). The both of microorganism then were cultured on Potato Dextrose Agar (PDA) which prepared by mixing 5.85 gr of PDA into 50 ml of aquades. PDA then was shrilled in autoclave temperature 121 ºC, 15 psi for 15 minutes. *Aspergillus niger* and *Trichoderma viride* cultured for 7 days in incubator temperature 30 ºC and then used to produce crude cellulase enzyme.

Harvesting and Analyzing Cellulase Enzyme Activity

Harvesting of crude cellulase enzyme was conducted by taking 1 gram of fermented substrate then mixed with 5 mL of aquades sterill. After that, substrate was under a 15 minutes shaking and 10 minutes centrifuge at 8000 rpm. Then the solution of crude cellulase enzyme was tooked 125µl and mixed with 125 µl of CMC as assay substrate. The solution of crude enzyme and CMC was incubated for 30 minutes to allow the reaction between enzyme and substrate. After 30 minutes, solution was added with 250 µl of DNS to stop the reaction. Then the solution was heated on water temperature 100 ºC for 10 minutes. After that absorbance value was measured with spectrophotometer on 540 of wave length. Absorbance value then was putted on standard curve [3].

Optimization of Cellulase Enzyme Production by *Aspergillus niger* and *Trichoderma viride*

Optimization of Incubation Time: Optimization of incubation time was conducted for 2, 4, 6, 8 and 10 days. 3 gram of water hyacinth as substrate was prepared and sterilized with autoclave temperature 121 ºC, 15 psi for 15 minutes. The culture of *Aspergillus niger* and *Trichoderma viride* were inoculated on steriled water hyacinth by dissolving spore of the both fungus with 5 ml steriled aquades and mixed with skewers. The solution of spore then was poured to water hyacinth as substrate in the laminar air flow in sterile condition. Then sample was stored in 30ºC of incubator. Water hyacinth substrate which was not inoculated with *Aspergillus niger* and *Trichoderma viride* used as control.

Optimization of Incubation Temperature: Optimization of incubation temperature was conducted after obtaining the optimum incubation time. Incubation temperature were 30ºC, 34ºC and 38ºC. In optimization of incubation temperature, the optimum incubation time was used as incubation time. 3 gram of water hyacinth (substrate) was prepared and sterilized with autoclave temperature 121ºC, 15 psi for 15 minutes. The culture of *Aspergillus niger* and *Trichoderma viride* were inoculated on sterilized water hyacinth by dissolving spore of the both fungus with 5 ml sterliized aquades and mixed with skewers. The solution of spore then was poured to water hyacinth as substrate in the laminar air flow in sterile condition. Then sample was stored in incubator 30 ºC, 34 ºC and 38 ºC. Water hyacinth substrate which was not inoculated with *Aspergillus niger* and *Trichoderma viride* used as control.

Optimization of Carbon Source: Optimization of carbon source was conducted by adding 2% (w/w) of carbon source on the water hyacinth as substrate. Carbon source which used in this study were glucose, sucrose, xylose and maltose. 3 gram of water hyacinth as substrate was prepared and added with 2% of carbon source then steriled with autoclave temperature 121 ºC, 15 psi for 15 minutes. The culture of *Aspergillus niger* and *Trichoderma viride* were inoculated on sterilized water hyacinth by dissolving spore of the both fungus with 5 ml sterilized aquades and mixed with skewers. The solution of spore then was poured to water hyacinth as substrate in the laminar air flow in sterile condition. Then sample was stored in incubator with optimum temperature and optimum incubation time. Water hyacinth substrate which was not added with carbon source used as control.

Optimization of Carbon Concentration: Optimization of Carbon Concentration was conducted after obtaining the optimum carbon source. Optimization of carbon concentration used several carbon concentration which were 2%, 4%, 6%, 8% and 10%. 3 gram of water hyacinth as substrate was prepared and added with 2%, 4%,

6%, 8 and 10% of carbon then sterilized with autoclave temperature 121 ºC, 15 psi for 15 minutes. The culture of *Aspergillus niger* and *Trichoderma viride* were inoculated on sterilized water hyacinth by dissolving spore of the both fungus with 5 ml sterilized aquades and mixed with skewers. The solution of spore then was poured to water hyacinth as substrate in the laminar air flow in sterile condition. Then sample was stored in incubator with optimum temperature and optimum incubation time.

Figure 1. SSF Fermentation

Figure 2. Crude Enzyme

Figure 3. Enzyme Assay

RESULTS

Optimization of Incubation Time

Celluase activity produced by *Aspergillus niger* and *Trichoderma viride* increased by increasing the incubation time. The optimum incubation time for *Aspergillus niger* and *Trichoderma viride* was 8 days of incubation time where the activity of cellulase enzyme were 2.40 U/g and 3.38 U/g for *Aspergillus niger* and *Trichoderma viride* respectively. The activity of cellulase enzyme by *Aspergillus niger* and *Trichoderma viride* decreased on 10 days of incubation time which were 1.77 U/g and 2.12 U/g respectively.

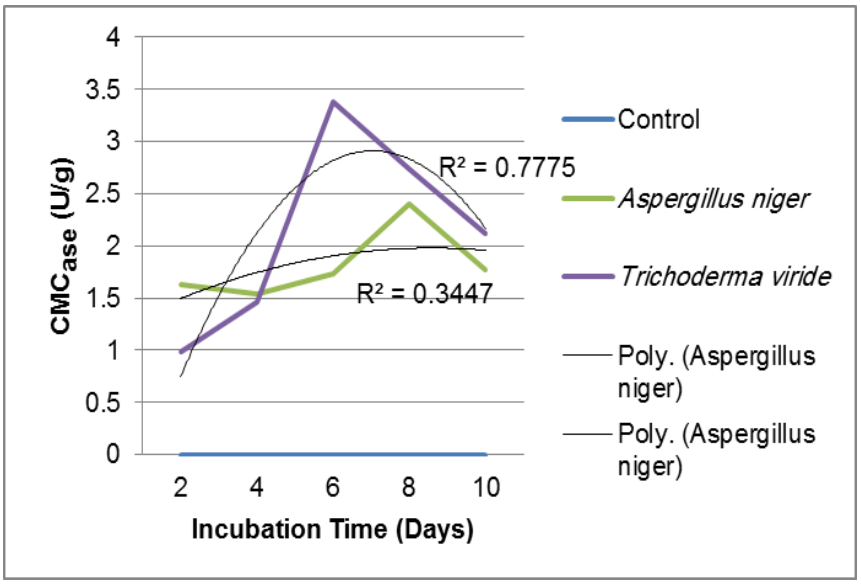


Figure 4. Effect of Differences Incubation Time for Cellulase Production

Optimization of Incubation Temperature

Cellulase activity produced by *Aspergillus niger* was optimum on 34 ºC of temperature which was 4.30 U/g. However cellulase activity produced by *Trichoderma viride* was optimum on 30 ºC which was 3.38 U/g.

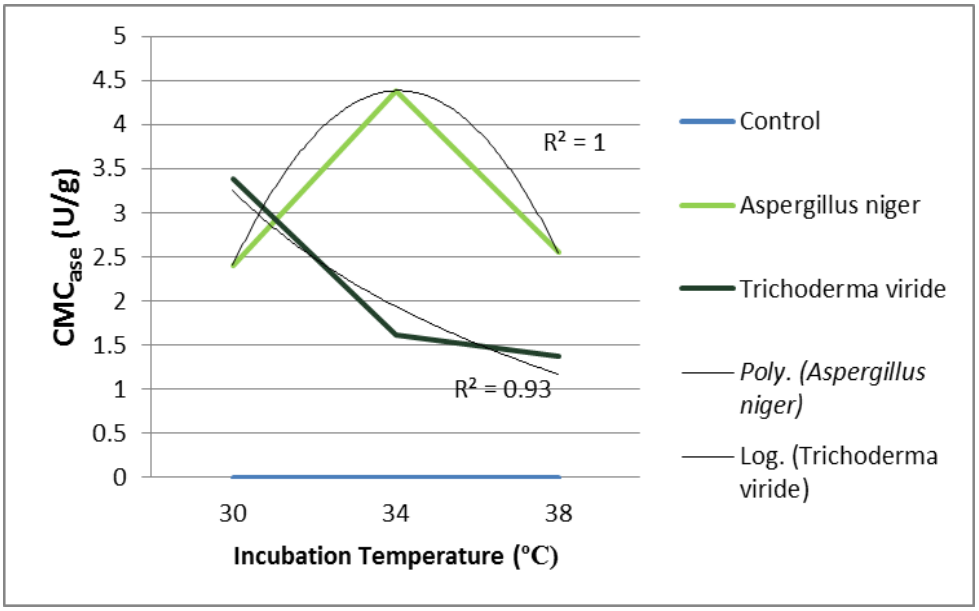


Figure 5. Effect of Differences Incubation Temperature for Cellulase Production

Optimization of Carbon Source

Carbon source which able to stimulate *Aspergillus niger* and *Trichoderma viride* to obtain the maximum cellulase activity was glucose. The maximum Cellulase activity by *Aspergillus niger* dan *Trichoderma viride* was obtained by glucose as carbon source were 5.62 U/g and 3.46 U/g respectively. The minimum sellulase activity by *Aspergillus niger* and *Trichoderma viride* was obtained with lactose as carbon source which were 4.28 U/g and 2.59 U/g respectively.

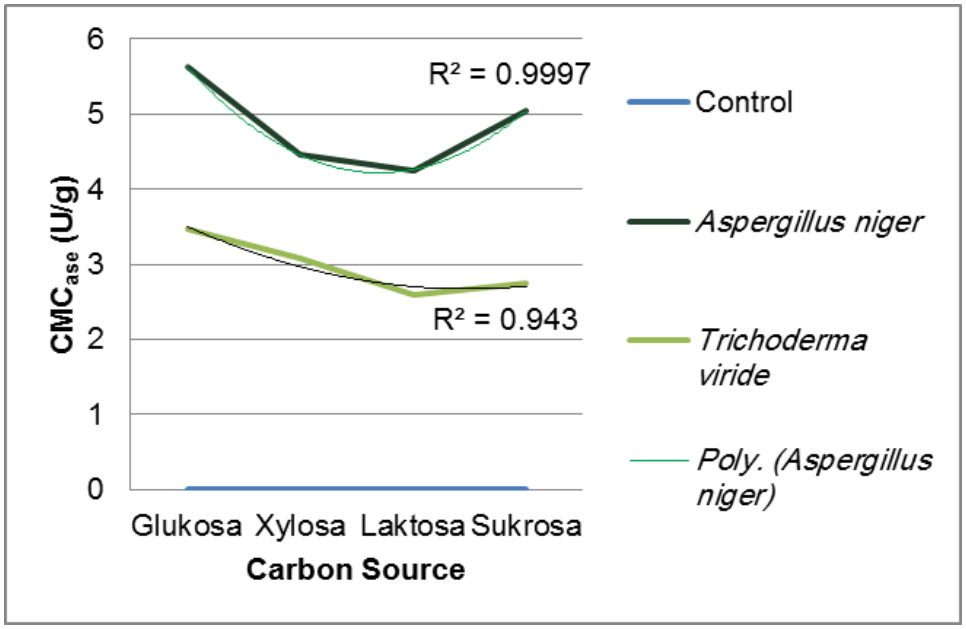


Figure 6. Effect of Differences Carbon Source for Cellulase Production

Optimization of Carbon Concentration

Optimum sellulase activity was obtained by adding 8% of carbon concentration both for *Aspergillus niger* and *Trichoderma viride*. Optimum cellulase activity by *Aspergillus niger* and *Trichoderma viride* were 5.83 U/g and 4.41 U/g respectively. However when carbon concentration was increased to be 10% cellulase activity both for *Aspergillus niger* and *Trichoderma viride* decreased to be 8.48 U/g and 2.21 U/g respectively.

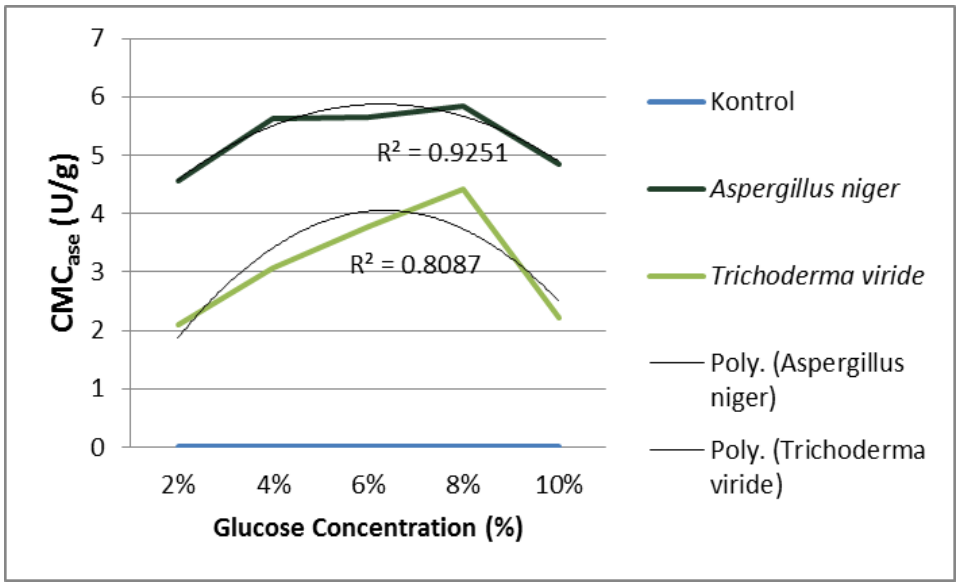


Figure 7. Effect of Differences Glucose Concentration for Cellulase Production

DISCUSSION

The decreasing of cellulase activity both by *Aspergillus niger* and *Trichoderma viride* on 10 days of incubation time suspected due to the effect of cellobiose accumulation which was the dimer of glucose. Cellobiose which was formed on 10 days of incubation time acted as agent which allow the mechanism of feedback inhibition which inhibit cellulase enzyme so that the activity of cellulase enzyme by *Aspergillus niger* and *Trichoderma viride* decreased [6, 7]. The differences of incubation temperature between *Aspergillus niger* and *Trichoderma viride* suspected due to the differences of living mechanism between the both microorganism. This result supported by Hammel et al. [8] and Mrudula [9] who reported that the optimum temperature of cellulase production by *Aspergillus niger* by using coconut peel was 34 ºC with the cellulase activity was 4.44 U/g. This result also supported by Murao [10] who reported that the optimum incubation temperature of cellulase production by *Trichoderma viride* by using corn cobs as substrate was 30 ºC with CMCase activity 1.88 U/g.

Glucose as carbon source which can stimulate *Aspergillus niger* and *Trichoderma viride* to produce the optimal sellulase activity suspected due to glucose was the carbon source which able to fill the carbon need for *Aspegillus niger* and *Trichoderma viride* without stimulate the effect of feedback inhibition [10]. Lactose as carbon source which produce the lowest selluase activity both for *Aspergillus niger* and *Trichoderma viride* suspected due to lactose was the most consumeable carbon affect the carbon supply for *Aspergillus niger* and *Trichoderma viride* higher than expected. The higher carbon than expected acted as agent which inhibit the function of cellulase enzyme or known as mechanism of feedback inhibition [1]. The addition of 2%, 4% and 6% of carbon concentration was not produce the optimum sellulase activity was suspected due to unable to fill the carbon need for *Aspergillus niger* and *Trichoderma viride*. The lack of carbon concentration for *Aspergillus niger* and *Trichoderma viride* could not stimulate the both microorganism to produce optimum cellulase enzyme [7, 14]. Furthermore the addition of10% of carbon concentration was higher than expected by both microorganism so that stimulate the effect of feedback inhibition. So that the optimum carbon source for *Aspergillus niger* and *Trichoderma viride* was 8%.

CONCLUSION

This research was conducted to determine the optimum condition of production cellulase enzyme by *Aspergillus niger* and *Trichoderma viride*. Optimum condition for cellulase production by *Aspergillus niger* was 8 days of incubation, 34ºC of incubation temperature and 8% of glucose concentration with 5.84 U/g of cellulase activity. However optimum condition for cellulase production by *Trichoderma viride* was 6 days of incubation, 30ºC of incubation temperature and 8% of glucose concentration with 4.41 U/g of cellulase activity. *Aspergillus niger* obtained higher sellulase activity compare to *Trichoderma viride*. So that for the next study cellulase enzyme can be

produced by using *Aspergillus niger*. Cellulase activity in this research was crude enzyme, for further study the experiment should be conducted by using pure enzyme for better result.

Acknowledgements

I would like to thank all the people who contributed on this research. First, thank to my academic advisor Mr. Dr. Joni Kusnadi, M.Si and Yusuf Hendrawan for guiding in process to finish my research. Then thank to Mr. Prof. Dr. I Made Sudiana, MSc for giving me chance to conduct my research at Cibinong Science Center of Indonesian Institute of Science. Also thank to LPDP for the scholarship of my master program and funding my research.

Authors' Contributions

Conception and design of this research: Elwin, Joni Kusnadi, Yusuf Hendrawan, I Made Sudiana.
Data analysis, drafting and revising the manuscript: Elwin

Competing interests

We declare that we have no significant competing financial, professional or personal interest that might have influenced the performance of presentation of the work described in this manuscript.

REFERENCES

1. Erdei B, Barta Z. 2010. Ethanol Production from Mixtures of Wheat Straw and Wheat Meal. *J. Biotechnology for Biofuels.* 3(3): 16-25
2. Tahir A, Madhila A, and Tasnim F. 2010. Effects of Cultural Conditions on Ethanol Production by Locally Isolated Saccharomyces cerevisiae BIO-7. *J. Applied Pharmacy.* 3(2): 72-78
3. Wheals AE, Basso LC and Alves DM. 1999. Fuel Ethanol after 25 Years. *J. Bioethanol Trend.* 12(1):482-487
4. Cheng NG, Hasan M, Kumoro AC. 2009. Production of Ethanol by Fed-Batch Fermentation. *J. Sci. Tech.* 2(3):399-408
5. Abubakar F and Oloyede O. 2013. Production and Activity of Cellulase from *Aspergillus niger* Using Rice Bran and Orange Peel as Substrate. *J. Sci. Res. Manage.* 1(5): 285-291
6. Deshpande S, Bhotmange MG, Chakrabarti T. 2008. Production of Cellulase and Xylanase by *Trichoderma reesei* (QM 9114), Aspergillus niger dan Mixed Culture by Solid State Fermentation of Water Hyacinth. *J. Emerg. Tech. Adv. Eng.* 15(3):449-456
7. Guatam SP, Bundela PS, and Pandey AK. 2010. Optimization of the Medium for the Production of Cellulase by The Trichoderma viride using Submerged Fermentation. *J. Environ. Sci.* 1(3): 656-665
8. Hammel ME, Ding SY, Johnson DK. 2006. Biomass Recal Citrance: Engineering Plants and Enzymes for Biofuels Production. *J. Sci.* 315(5): 804-807
9. Mrudula S and Murugammal R. 2001. Production of Cellulase by *Aspergillus niger* Under Submerged Fermentation Using Coir Waste as A Substrate. *Braz. J. Microbiol.* 42(1): 1119-1127
10. Murao S, Sakamoto R and Arai M. 1998. Cellulase of *Aspergillus aculeatus* in Method in Enzymology, London. Academic Press Inc.
11. Awatshi M, Jeewanjot K and Shiwali R. 2013. Bioethanol Production Trough Water Hiyacinth via Optimization of the Pretreatment Condititon. *J. Emerg. Tech. Adv. Eng.* 3(3): 42-46
12. Bradford MM, 1976. A Rapid and Sensitive Method for The Quantitation of Microorganism Quantities of Protein Utilizing the Principle of Protein-dye Binding. *J. Anal. Chem.* 7(2): 248-254
13. Yitzhak H. 2013. Sources for Lignocellulosic Raw Materials for the Production of Ethanol, Berlin. Springer
14. Zaldivar J, Nielsen J and Olsson L. 2001. Fuel Ethanol Production from Lignocellulose: A Challenge for Metabolic Engineering of Biocatalysts for Fuel Ethanol Production. *J. Microbiol. Bioethanol.* 56(2): 17-34

2017 SCIENCELINE
Journal of Life Science and Biomedicine
J Life Sci Biomed, 7(2): 19-25, 2017

ISSN 2251-9939

On the Physiology of Immune System

Abhay Kumar Pandey[1], Garima Pandey[1] and Bajarangprasad L Pandey[2]

[1]*Department of Physiology, Government Medical College, Banda, Uttar Pradesh*
[2]*Department of pharmacology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh*
Correspondence: Dr. Abhay Kumar Pandey. Assistant Professor; Department of Physiology, Government Medical College, Banda, Uttar Pradesh, 210001, Email: drabhaypphysiol@gmail.com

ABSTRACT

The immune system distinctively has predominant concern of qualitative homeostasis. It serves housekeeper role for factors (majority of them, have endogenous origin) appearing as dangers for homeodynamics of the organism. Precisely, the immune system endeavors in dynamic optimal self maintenance within an organism which constantly faces varied infringements from the environment. Processes of growth, development and aging are all under supervision of immune system. The brain beholds perceptive topographic map of body architecture to both sense and issue actions in specified direction. The immune cells also behold broad image of the whole immunological self. By referring to this, the cells notice a danger molecule which is structurally non-conforming. This map is integrated with the antibody forming system or response forming system of these cells. Ability of immune system to detect unwelcome entries and then alert its various cell groups as well as the brain puts it at par with sensory organ. Classical features include active interactions with hypothalmo-pituitory-adrenal axis (HPA) or with autonomic nervous system mediated through specific peripheral and central cytokines. Immune system is committed to preservation of self by neutralizing dangers and keeps constancy and integrity of the organism. Immune response is evoked for restoring homeostasis consequent to damage. Secondly, interactions between activating and inhibiting mechanism of immune response needs to be optimally balanced.

Review Article
PII: S225199391700004-7

Rec. 01 Nov. 2016
Acc. 15 Feb. 2017
Pub. 25 Mar. 2017

Keywords

Hysiology, Immune system, Developmental biology, Neuroregulation

INTRODUCTION

Homeostasis in physiology refers much to quantitative balance. The immune system has distinctive concern of qualitative homeostasis. It serves housekeeper for largely endogenous factors perceived as dangerous for homeodynamics of the organism Amidst contradictory cells and molecules gaining entry into the organism harmonization of self has been indispensable for evolution. Such a role play by immune system possibly, evolved the capability to mount struggle against the non-self invaders as well [1]. Immune system carries out self maintenance, repairs, construction and optimization dynamically within an organism in face of varied infringements from environment [2]. A potentially dangerous molecule, including foreign molecules are identified and blocked. The system exhibits tolerance to commensale microbes and the fetus. The evolutionary tolerogenic adaptation of immune system as well as the stated objects is thus evident [3]. The immune system is disarmed against such foreign cells. The incompetent struggle mounted by the immune system to discard these entities, results in awakening of more of the genes and synthesis of products. The later that impart wider capabilities, particularly of repair and regeneration to meet higher rates of wear and tear during pregnancy and confinement.

Processes of growth, development and aging are all under supervision of immune system. Immune system has necessary ability to read genetic information in target cells to respond to them appropriately. This is facilitated by

free dissipation of cells. In contrast, neurons and endocrine cells that release neurotransmitters and hormones are not mobile. Mobile immune cells may reach their targets and inspect them through close contact.

Distinction between molecules is necessary for regulatory processes. The brain beholds perceptive topographic map of body architecture. Such map enables to sense exigencies and direct appropriate response. Immune cells also behold broad immunological image or map of self for reference to distinguish a nonconforming danger molecule. This map is integrated with the antibody and other response forming cells of immune system.

Danger recognition by immune cells is influenced also by receptors for hormones, autacoids, neurotransmitters, on these cells. Immune system on the other hand has potential to form auto antibodies against such regulatory molecules and their receptors. Immune system can therefore regulate respective functions along regulation by those molecules, viz, cell proliferation, differentiation, apoptosis (programmed death) and such genetically controlled molecular and cellular processes [4]. Auto-antibodies or anti-idiotypes exhibiting similar or opposite biological activities as those of hormones, autacoids, enzymes and drugs are well demonstrated in sick as well as healthy people [5].

Above scenario raises possibility that immune system may transgress the functional domains served by different specialized regulatory systems in body. The phenomenon on the other hand offers possibility of using anti-idiotypes for correcting genetic absence of some functional biomolecules. Anti-idiotypes to constituent bio-molecules normally formed in "physiological quantities" in healthy people may be harvested and administered in individual genetically deficient in concerned biomolecules. That should provoke immune response and generation of specific antibodies to the foreign anti-idiotype. There is good possibility of such antibodies being structurally similar to missing bio-molecules and may even function like them.

Early prenatal and postnatal patterning of Immune System

Environmental factors like malnutrition, stress or toxins affecting maternal immune system may disrupt development of fetal immune system. Interactions of maternal immune cells in decidua with trophoblast antigens and regulatory influence of immune cytokines, ensures tolerance to fetal/placental antigens by mother's immune system. The arrangements critically serve maintenance of pregnancy, development of fetal immune system and the competence of maternal immune system itself. Maternal and infant nutritional inadequacies can modulate the development of immune function [6]. The immunologic and regulatory framework in offspring can be permanently altered, determining risks for later disease [7]. Nutrition is basic need for organogenesis, normal proliferation of cells and synthesis of secretary products including cytokines, acute phase protein etc. The later is also essential to development of immune response machinery. Some nutrients are specifically needed for induction of control mechanisms in immune response e.g. antioxidants [8]. Nutrient deficiencies of mother compromise proper morphogenesis of placenta and restrict nutrient supply of fetus with profound global consequences to developing anatomy and physiology. The genetic programming also gets impacted [6, 9].

Food antigens in infant influence development of immune function through complex interactions with microbial flora of gut [10, 11]. Optimal oral tolerance to dietary constituents takes place early in 4 to 6 postnatal months. Failures of the same leads to food allergies, celiac and other inflammatory gut diseases [12]. There is critical involvement of many micronutrients in normal developmental processes of diverse capabilities of immune system. Nutrient factors related to single carbon metabolism, choline, folate (critically needed for DNA methylation) and Vit. $B_{2,}$ $B_{6,}$ and B_{12} are key modulators of epigenetic priming [6, 13]. Defective epigenetic priming of immune systems is linked to risk of allergic disorders [14]. Very important role in lymphocyte proliferation and differentiation, i.e. formation of regulatory T lymphocytes is ascribed to various fat soluble vitamins, viz. D, A, and E [15, 17]. Elemental zinc also has important role in lymphopoiesis and haematopoiesis.

The developing fetal metabolizing systems are vulnerable to toxic substances in mother's food (e.g. pesticides) which cross over to fetus and infant through placenta and breast milk. These may be detrimental to the immune function. Postnatal feeds influence the gut micro biota which interacts with gut mucosa to induce tolerance for commensales and ability to recognize pathogens. Humoral players of these interactions also influence the important central regulatory mechanism of immune responses namely, the hypothalamo-pituitary-adrenal axis. Malnutrition causes activation of the HPA axis and consequent suppressed immune function [18]. The permanent alterations in patterns of neuroendocrine-immune interaction lead to attenuation of inflammatory responses or reduced resistance to nidation and colonization of any tumor cells.

Maternal stress consequent to infection and inflammation involves increased expression of proinflammatory cytokines that are transmitted through placenta and breast milk for foetus/infants. Malnutrition partly determines quality (kind), quantity as well as transport of these mediators. Both a deficit of required nutrient/s or excess of

nutrients adversely impact immune functions. Cytokines would elevate HPA axis activity in fetus or infants, to increase glucocorticosteroid hormone levels. This has immunosuppressive effect, predominantly on the cell mediated Th1 type immune response. There is a shift toward the Th2 type immune responses and predisposition to allergic disorders [14, 19, 20]. Mental stress in mother also heightens HPA axis sensitivity in fetus. Normal gut flora that helps maturation of proper immune response, may be distorted by early antibiotic exposures. This may also shift immune response toward Th2 dominance, increasing risk of allergies and asthma [11, 21].

Functional scheme and regulation of immune system

The basic physiology limited to immune system itself may be narrated in idiotype-anti idiotype concept of antibodies and immune response. Immune system may be akin to a sensory organ given the ability to detect unwelcome entries and then alert its various cell groups as well as the brain. Immune system physiology essentially comprises understanding interactions of its constituents with other physiological systems. As a classical physiological system it actively interacts with hypothalmo-pituitory-adrenal axis (HPA) [14], or with sympathetic nervous system (even parasympathetic nervous system) [22, 23]. These interactions are mediated through specific peripheral and central cytokines. Immune system is physiological homeostatic system committed to preservation of self by neutralizing dangers and maintaining constancy and integrity of the organism. Immune function is unique in simultaneous and intertwined operation of physiological as well as pathological processes [24]. Different cells and mediators are put into action at different stages of the innate and adaptive immune responses. Precise synchronous changes in neural and endocrine activities provide its essential extrinsic regulation independent of consequences of stress or pathological state.

Interaction with antigen activates the immune cells to produce and release cytokines. The cytokines activate HPA axis leading to increased glucocorticosteroid secretion. The hormone suppresses incompletely activated or un-involved immune cells, but does not affect cells actively engaged in immune response [14]. Immune response is thus restricted to genuine requirement with enhanced specificity. This mechanism averts emergence of autoimmunity and excess proliferation in organs of the immune system.

The peripheral immune mechanism and endocrine responses under control of brain represent the long loop of regulatory circuit. Sympathetic nerves make close contact with immune cells in innervated lymphoid organs exerting inhibitory control. The later control is relaxed during active immune response. This is local short regulatory loop of neuro-humoral immune regulation [14].

Immune system reacts to antigen by informing the brain through variety of cytokines which also stimulate the HPA axis and inhibit nor-adrenaline turnover in hypothalamus besides some other hormonal effects [25]. Stimulation of β-2 adrenocepters by adrenaline and nor-adrenaline on the immune cells damps down release of pro-inflammatory cytokine. These effects occur on the antigen presenting macrophages and the effector Th-1 lymphocytes. In contrast the Th-2 lymphocytes get stimulated to liberate anti-inflammatory cytokines. Catecholamines therefore selectively suppress the inflammation and cellular immune response effected by Th-1 cells [26]. Both, catecholaminergic and serotonergic systems are dominant in integral control of immune function by brain [26, 27].

Cytokines interleukin IL-1 causes HPA axis activation through catecholaminergic mechanisms. Other neurophysiologic effects caused by cytokines are pyrexia, changes in appetite, sleep pattern, learning and memory. Both a direct impact on neurons through vasoendothelial-glial interface and by way of afferent vagus nerve impulses are involved in cytokine action [28, 29]. Humoral and neurotransmitter links of peripheral immune activity may induce expression of specific genes for cytokines and their receptors in specific regions of brain [30, 31]. Such signaling affects immune mechanisms in coherence to homeostatic adjustments in pathological state. Sympathetic activity causes circulatory enhancement facilitating passage of immune cells to conflict site. From the blood vessels and lymphatics these cells migrate and establish at site of action. The process is guided and controlled by adhesion molecules, chemokines, integrins and local factors [32]. Splenic link with circulation allows clearance, uptake and retention of microbes and their contact with immune cells. Systemically the cytokines increase sympathetic activity but high cytokine concentrations at action site inhibit neuronal nor-epinephrine release. Such strategic effect redistributes peripheral blood flow to flush the sites [33]. This enhances contact of antigen with immune cells necessary for mounting the immune response. Interleukin-1 exhibits strong potential of promoting glucose transport and oxidation in adipose tissue and fibroblasts. It also influences control of brain glucose utilization [34]. The peripheral and central IL-1 actions collectively channel glucose availability in lymphoid organs and inflammation site to sustain high energy needs of active immune response.

Inflammatory and autoimmune phenomena are crucially controlled by the immune-HPA circuit. Dysfunction of the circuit associates autoimmune inflammatory disorders [14, 35]. Auto-immunity is suppressed also by sympathetic nervous activity which promotes apoptosis in activated effectors lymphocytes during immune response [36]. Parasympathetic activation through the nicotinic receptor mechanism inhibits release of pro-inflammatory cytokines limiting the inflammatory process [37]. Catecholaminergic system co-localizes with specific neuro-peptide that exhibit pro or anti-inflammatory consequences in animal models of auto-immunity and modulate HPA axis function [38].

Cytokines produced in healthy brain play role in neurophysiology [31]. Their influence on neuro-endocrine control of homeostatic set points is vital immune-physiologic function. Antigen presenting cells are present in all organs and are influenced by hormonal and neurotransmitter mechanisms [8]. Most pathological states comprise of an inflammatory immune component that interacts with neuro-endocrine mechanisms. The demarcation between physiological and pathological is subject to decoding of the finite message carried by molecular mediators. The message depends on variety of states of time and site of microenvironment as well as the specific target.

The essential scavenging function

Immune function serves elimination of intruding microbes and immune complexes. This ability has evolved from extension of debris (of dying cells) removing function of immune system. Macrophages express Toll like receptor (recognizing non-self molecular patterns) and scavenger receptors (recognizing modified-self and alien protein structural patterns) for clearing endogenous and exogenous unwelcome products [39]. Intact cells (self or alien and old or young) and molecules (useful or waste) are not sensed by these cells. Only when auto-antibodies attach a target, it is signified for removal to the macrophages. The macrophages then bind by their membrane-born F_c-receptors to such targets (the soluble or particulate antigen-antibody complexes) and endocytose them for breakdown and elimination. The referred auto-antibodies are known as opsonins. Their guidance to macrophages is like that of scent, which enables dogs to recognize suspect objects. The quantity of processed antigen made available for recognition of immune competent cells, serves as regulator by positive feedback to the production of antibodies. This helps to maintain steady individual rates of apoptosis/replacement of specialized cells in healthy state. The different auto-antibodies also remain within defined 'physiological levels', not varying with age or sex [40]. Level of such organo-tropic auto-antibodies increases upon target organ pathology with increased cellular apoptosis releasing organ specific antigens. Such organotropic auto-antibodies therefore serve as biomarkers for specific organ pathology.

The Feto-Maternal harmonization and tolerance

Phylogeny and fetal development constitute essential physiology involving autoimmune harmonization. Fetal cells enter in to maternal circulation and this microchimerism is high in women bearing many pregnancies. The maternal immune system certainly attempts to mount immune response against the fetal cells but that is cut down to so called 'physiological' level. Partial elimination of invading fetal cells does occur without eruption of auto-immune disorder. The phenomenon is a defensive mechanism for sustaining pregnancy [41, 42]. The fetal cells are able to proliferate in mother due to physiologic regulation of auto-immunity and provide for repair and regeneration of damaged maternal tissues with fetal stem cells. In long run the subdued biological tussle envigourates maternal system serving as one basis of longevity of women [43]. The same may also contribute to higher incidence of auto-immune diseases in the female [44].

During the first trimester of pregnancy, decidual natural killer cells (dNK) localize in decidua, which facilitate trophoblastic invasion and growth of placental blood vessels. Interaction of dNK cells with trophoblast cells occurs through two kinds of receptors. A killer type and killer-inhibitory type receptors (KIR). The KIRs recognize Major Histo Compatibility Complex class-1 (MHC-1) present on nucleated cells.KIR signals dominate dNK cell behavior. Abnormal or damaged fetal cells lacking proper MHC-1 tag are destroyed [45]. The cytotoxicity of dNK cells is suppressed and trophoblast cells are spared of maternal immune attack. Such suppression results from strong activation of KIRs by interleukin IL-10, the class 1b (HLA E or G) molecules and class 1a alleles of HLA-C2 [46, 47].

An immune-depressant micro-environment is generated by cytokine IL-10 secreted by M2 sub-phenotype derived from the decidual macrophages [48]. Treg cells dominate the suppressor Treg/inducer T_{17} lymphocytes balance during pregnancy which is major determinant of maternal immune tolerance to fetus [49]. The Treg lymphocyte suppressor function begins even before fertilization to guard paternal antigens in insemination fluid [50].

Immune auto-reactivity and Auto-immunity

Sometimes a normal immune response may be feeble, less specific and badly driven. Perpetuation of the same would be detrimental to organism. Macrophage recognition and elimination of apoptotic debris is diminished in connective tissue disorders as systemic lupus erythematosus [51, 52]. Piled up apoptotic material is likely to be picked up for antigen processing and consequent signaling of auto-reactive lymphocytes. The auto-reactive process then exceeds ordinary or physiological limits. Even then this helps speedy clearing of aberrant cells restoring healthy organ function. The auto-antibodies stimulate repair function such as increased DNA synthesis, mitotic rate and cell proliferation [5, 53]. Raised auto-antibody level above the physiological limits indicate increased rate of apoptosis. This occurs much before dysfunction of organ detected in biochemical abnormalities and clinical manifestation. Organ non-specific auto-antibodies are also elevated years before occurrence of autoimmune disorders [54]. An autoimmune response (excess of the need to clear apoptotic matter) is mostly consequent to poor regulation.

Autoimmunity is kind of an adaptive secondary immune response. It is aberrant since it is not conditioned to serve need of the organism. Hereditary predilections to autoimmune diseases point to genetic aberrations and/or epigenetic changes resulting from environmental factors. These crucially alter the magnitude/intensity of immune response [55-57]. Unique change in bio-molecular structure amid pathologic states [58], or mimicry of nucleic acid products to those of infective microbes in damaged cells [59] may make them appear as alien antigens to the immune cells to mount autoimmune response. Encounter of immune cells with such immunogenic substances may increase also with failure of cellular organelles to capture and check such molecules [57]. Adverse environments cause epigenetic changes and stress in the host may cause hypo or hyperactive neuro-endocrine functions [23].These would tilt immune responses toward Th-1 or Th-2 over-activity patterns [60]. Thus, internal and external aberrations on varied accounts may promote and erupt autoimmunity [61].

Epilogue

The immune response is evoked to restore homeostasis upon encountering external intruders or endogenous products of tissue damage. Synergic balanced interactions between activating and inhibiting mechanism of immune response ensure defense and avoid severe immune pathologies. The differences of molecular mechanisms involved in sensing danger from the self derived versus foreign entities needs finite understanding as prerequisite to understand autoimmunity [23]. The apparent contradiction in rejection of transplants but not pregnancy by the immune system has resolved with such understanding. Immune system seems cognizant of disturbances in milieu and decides about using only innate or also adaptive kind of responses. The later is based on overall sensory and referent integration.

The normal physiology of T and B lymphocytes includes weak self-reactivity. That serves maturation and diversity of immune potential. That also regulates cell survival to the optimum span for integrity of function and health. Immune system is fundamentally tuned to serve physiological role and naturally acquires learning toward stepping in to war against unwelcome molecules and cells. The academic tradition prevailing for more than a century, has largely denied basic and applied physiological view of the immune system. This article emphasizes such view beyond the realm dominated by the 'foreign' and the 'abnormal'. Such a view ought be useful for holistic understanding of immune system.

Authors' Contributions

All authors contributed equally to this work.

Competing interests

The authors declare that they have no competing interests.

REFERENCES

1. Metchnikoff E. 2000. The evolutionary biology papers of Elie Metchnikoff-1892. Gourkoh Williamson DI, Tauber AI (Eds). *Kluwer Academic Publ, Durdrecht*, 207-216.
2. Tauber A.I. 1991. The Immunological Self, a centenary perspective. *Perspect Biol Med.* 35, 74-86.
3. Metzinger P. 2002. The danger model: a renewed sense of self. *Science*, 296: 301-305.
4. Poletaev A, Osipenko L. 2003. General network of natural auto-antibodies as immunological Humunculus (Immunculus). *Autoimmunity Rev.*, 2: 264-271.

5. Farid-Nadir R, Linticum D.S. 1988. Anti-Idiotypes, Receptors and Molecular mimicry. Springer Verlag New York, p-317.
6. Pandey AK. And Pandey G. 2017. Epigenetics and systems physiology of nutrition: an overview. *Adv Diabetes Metabol,* 5(1):6-11.
7. Palmer A.C. 2011. Nutritionally mediated programming of the developing immune system. *Adv Nutr (Supl*). 2:377-395.
8. Pandey G Pandey S S Pandey A K Pandey B L. 2016. Psoriasis: The implications of oxidative stress led pathogenesis for dietetic interventions. *Innovare J Med Sci* , 4(5):1-4.
9. Jansson T., Powell T.L. 2007. Role of the placenta in fetal programming: underlying mechanisms and potential interventional approaches. *Clin Sci (Lond).* 113: 1-13.
10. Calder P.C., Kraus-Etschmann S, de Jong E.C., Dupont C., Park J.S. 2006. Early nutrition and immunity: Progress and Perspective. *Br J Nutr*, 96: 774-790.
11. Pandey G Pandey A K. 2016. Biology and Medicine of Microbiome. *Innovare J Medical Sci*, 4(6):4-5.
12. Verhasselt V. 2010. Oral tolerance in neonates: from basics to potential prevention of allergic disease. *Mucosal Immunol.* 3: 326-333.
13. Domingnez-Salas P., Lox S.E., Prentice A.M., Henning B.J., Moore S.E. 2012. Maternal nutritional status, C(1) metabolism and offspring DNA methylation: a review of current evidence in human subjects. *Proc Nutr Soc.* 71: 154-165.
14. Pandey G Pandey A K Pandey S S Pandey B L. 2015. Microbiota in immune pathogenesis and prospects of pre and probiotic dietetics in psoriasis. *Biomedical Res J*, 2(2): 220-232.
15. Wintergerst E.S., Maggini S, Horing D.H. 2007. Contribution of selected vitamins and trace elements to immune function. *Ann Nutr Metab.* 51: 301-327.
16. Sun C.M., Hall J.A., Blank R.B., Bouladoux N., Oukka M., Mora J.R. et al. 2007. Small intestine lamina propria dendritic cells promote de-novo generation of Fox P_3 Treg Cells via retinoic acid. *J Exp Med.* 204: 1775-1785.
17. Devereux G. 2010. Session 1: Allergic disease: Nutrition as a potent determinent of asthma. *Proc Nutr Soc.* 69: 1-10.
18. Seckl I.R., Meaney M.J. 2004. Glucocorticoid programming. *Ann N Y Acad Sci.* 1032: 63-84.
19. Elenkov I.J. 2004. Glucocorticoids and the Th1/Th2 balance. *Ann N Y Acad Sci.* 1024: 138-146.
20. O'Connor T.G., Winter M.A., Hann I., Carnaham J., Pressman C.K., Glover V. 2013. Prenatal maternal anxiety predicts reduced adaptive immunity in infants. *Brain Behav Immun.* 32: 21-28.
21. Jensen S.M., Bennelykke K., Bisgaard H. 2012. Use of antibiotics during pregnancy increases risk of asthma in early childhood. *J Paed.* 162: 832-838.
22. Pandey B L Das P K 1988. Immunopharmacological studies on Picrorhiza kurroa Royle ex Benth part III:Adrenergic mechanisms of anti-inflammatory action. *Indian J Physiol Pharmac*, 32:120-125.
23. Pandey G Pandey A K 2013. Nutrition research perspective in immune mediated inflammatory disorders. *Indian J Rheumat*, 8:30-36.
24. Pandey A K, Pandit A, Pandey-Bahuguna D, Pandey B L. 2015. Biological perspectives of "Trade off" between aging and cancer. *Journal of Advancements in Medical & Life Sciences*, 3(1):1-5.
25. Turnball A.V., Revier C.L. 1999. Regulation of the hypothalamic-pituitory-adrenal axis by cytokines: actions and mechanisms of action. *Physiol Rev*., 79: 1-71.
26. Elenkov I.J.,Wilder R.L., Chrouses G.P., Vzi E.S. 2000. The sympathetic nerve: an integrative interface between two super systems- The brain and the immune system. *Pharmacol Rev*., 52: 595-638.
27. Hempfling C, Neuhuber WL, Wörl J. 2012. Serotonin immunoreactive neurons and mast cells in the mouse esophagus suggest involvement of serotonin in both motility control and neuroimmune interactions. *Neurogastroenterol Motil*., 24(1):e67-78.
28. Dentzer R. 2004. Cytokine induced sickness behavior- a neuro-immune response to activation of innate immunity. *Eur J Pharmacol.* 500: 399-411.
29. Maier S.F., Goehler L.E., Fleshner M., Watkins I.R. 1998. The role of the vagus nerve in cytokine to brain communication. *Ann N Y Acad Sci*., 840: 289-300.
30. Pitossi F., del Rey A., Kebiersch A., Bysedovsky H. 1997. Induction of cytokine transcripts in the nervous system and pituitory following peripheral administration of endotoxin to mice. *J Neurosci Res.* 48: 287-298.
31. Pandey A K. 2017. Disruption of Neurosynaptic Physiology and Neuron Network Dysfunction in Brain Disorders: An Environmental and Occupational Health Perspective. Journal of Alzheimers and Neurodegenerative Diseases. (in press).
32. Pandey A K. 2014. Physiology of Tooth Eruption. *Indian J Dentist*, 5:48-51.
33. Rogausch H., del Rey A., Kebiersch A., Reschke W, Ortel J., Bysedovsky H. 1997. Endotoxin induces vasoconstriction in the spleen: role of endogenous interleukin-1 and sympathetic innervations. *Am J Physiol*., 272: R 2048- R2054.
34. del Rey A., Besdovski H. 1992. Metabolic and neuro endocrine effects of pro-inflammatory cytokines. *Eur J Clin Invest*,. 22(Supl-1): 10-15.
35. Sternberg E.M. 2006. Neural regulation of innate immunity: a co-ordinated non-specific host response to pathogens. *Nat Rev Immunol.* 6: 318-328.
36. del Rey A., Kebiersch A., Petzoldt S., Bysedovsky H. 2002. Involvement of nor-adrenergic nerves in the activation and clonal selection of T cells stimulated by super antigen in vitro. *J Neuroimmunol*., 127: 44-53.
37. Tracey K.J. 2002. The inflammatory reflex. *Nature.* 470: 853-859.

38. Nusdorfer G.G., Malendowicz L.K. 1998. Role of VIP, PACAP and related peptides in the regulation of the hypothalmo-pituitory-adrenal axis. *Peptides*. 19: 1443-1467.
39. Pandey AK, Pandey G, Pandey SS, Pandey BL. 2014. Human Biology of Diet and Lifestyle Linked Chronic Inflammatory Non-Communicable Disease Epidemic. *Human Biol Rev*, 3:25-42.
40. Poletaev A and Boura P 2011. The immune system,natural autoantibodies and general homeostasis in health and disease. *Hippokratia.*, 15:295-298.
41. Lee Nelson J. 2002. Pregnancy and microchimerism in autoimmune disease: Pretector or insurgent? *Arthritis Rheum*. 46: 291-297.
42. Klintscher M, Schwaiger P., Mannweiler S. et al. 2001. Evidance of fetal microchimerism in Hashimoto's thyroiditis. *J Clin Endocr Metab*., 86: 2494-2498.
43. O!Donogue K. 2008. Fetal microchimerism and maternal health during and after pregnancy. *Obstet Med*, 1:56-64.
44. Tolal N. 1989. Autoimmunity and sex revisited. *Clin immunol immunopathol.,* 53: 355-357.
45. Morella A, Biassori R, Battino C, Pende D, Vitale M, Poggi A et al. 1997. Major Histocompatibility Complex Class 1-specific receptors on human natural killer and T lymphocytes. *Immunol Rev*., 155: 105-117.
46. Mold IE, Mc Cuune IM. 2012. Immunological tolerance during fetal development: from mouse to man. In, Advances in Immunology, Frederick WA (ed). Academic Press. Boston MA. P73-112.
47. Erlbacher A. 2013. Immunology of the maternal-fetal interface. *Annu Rev Immunol.,* 31: 387-411.
48. Renauds I, Graham CH. 2008. The role of macrophages in utero-placental interactions during normal and pathological pregnancy. *Immunol Invest*., 37: 535-564.
49. Gustafson C, Mjosborg J, Matussek A, Geffers R, Methiessen L, Berg G et al. 2008. Gene expression profiling of human decidual macrophages: evidence for immunosuppressive phenotype. *PLoS One*, 3: e2078.
50. Robertson SA, Guerin LR, Bromfield JJ, Branson KM, Ahlstrom AC, Care AS. 2009. Seminal fluid drives expansion of the CD4+ CD25+ T regulatory cell pool and induces tolerance to parental alloantigens in mice. *Biol Repord.,* 80: 1036-1045.
51. Kuhn A, Sheriff A. 2006, Clearance of apoptotic cells in human SLE. Curr Direc Autoimmun., 9: 173-187.
52. Munoz LE, Gross mayer G. 2007. Clearance deficiency and systemic Lupus Erythematous. *J Autoimmunity*. 28: 114-121.
53. Ruiz-Arguelles D, Alarcon-Segovia D. 2001. Penetration of auto-antibodies into living cells. *IMAJ*. 3: 121-126.
54. Notkins AL. 2007. New predictors of disease. *Sci Am*. 3: 72-79.
55. Chen GY, Tang J, Zhong P, Liu Y. 2009. CD24 and Siglec 10 selectively repress tissue damage induced immune responses. *Science*. 323: 1722-1725.
56. O'Connell RM, Rao DS, Chaudhuri AA, Baltimore D. 2010. Physiological and pathological roles for microRNAs in the immune system. *Nat Rev Immunol*. 10: 111-122.
57. Nakashira K, Haspel JA, Rathinam VAK et al. 2011. Autophagy proteins regulate innate immune responses by inhibiting the release of mitochondrial DNA mediated by NALP-3 inflammasome. *Nat Immunol.,* 12: 222-230.
58. Baum LG, Crocker PR. 2009. Glycoimmunology: Ignore at your perils. *Immunol Rev*., 230: 5-8.
59. Theofilopoulas AN, Kono DH, Beutler B, Baccala R. 2011. Intracellular nucleic acid sensors and autoimmunity. *J. Intereron Cytokine Res*. 31: 867-886.
60. Elenkov I J.Chrousos GP. 2002. Stress hormones, proinflammatory and anti-inflammatory cytokines and autoimmunity. *AnnN Y Acad Sci*, 966:290-303.
61. Bianchi ME, Manfredi AA. 2009. Dangers in and out. *Science*. 323: 1683-1684.

Instructions for Authors

Manuscript as Original Research Paper, Review and Case Reports are invited for rapid peer-review publishing in the *Journal of Life Science and Biomedicine*. Considered subject areas include: Biocontrol, Biochemistry, Biotechnology, Bioengineering, Neurobiology... view full aims and scope

JLSB EndNote Style
Manuscript Template (.doc)
Sample Articles
Declaration form
Policies and Publication Ethics

Submission

The manuscript and other correspondence should preferentially be submit online. Please embed all figures and tables in the manuscript to become one single file for submission. Once submission is complete, the system will generate a manuscript ID and will send an email regarding your submission. Meanwhile, the authors can submit or track articles via editors@jlsb.science-line.com ; jlsb.editors@gmail.com. All manuscripts must be checked (by English native speaker) and submitted in English for evaluation (in totally confidential and impartial way).

Supplementary information

The online submission form allows supplementary information to be submitted together with the main manuscript file and covering letter. If you have more than one supplementary files, you can submit the extra ones by email after the initial submission. Author guidelines are specific for each journal. Our Word template can assist you by modifying your page layout, text formatting, headings, title page, image placement, and citations/references such that they agree with the guidelines of journal. If you believe your article is fully edited per journal style, please use our MS Word template before submission. **Supplementary materials** may include figures, tables, methods, videos, and other materials. They are available online linked to the original published article. Supplementary tables and figures should be labeled with a "S", e.g. "Table S1" and "Figure S1". The maximum file size for supplementary materials is 10MB each. Please keep the files as small possible to avoid the frustrations experienced by readers with downloading large files.

Submission to the Journal is on the understanding that

1.The article has not been previously published in any other form and is not under consideration for publication elsewhere;
2.All authors have approved the submission and have obtained permission for publish work.
3.Researchers have proper regard for conservation and animal welfare considerations. Attention is drawn to the *'Guidelines for the Treatment of Animals in Research and Teaching*'. Any possible adverse consequences of the work for populations or individual organisms must be weighed against the possible gains in knowledge and its practical applications. If the approval of an ethics committee is required, please provide the name of the committee and the approval number obtained.

Ethics Committee Approval

Experimental research involving human or animals should have been approved by author's institutional review board or ethics committee. This information can be mentioned in the manuscript including the name of the board/committee that gave the approval. Investigations involving humans will have been performed in accordance with the principles of Declaration of Helsinki. And the use of animals in experiments will have observed the *Interdisciplinary Principles and Guidelines for the Use of Animals in Research, Testing, and Education* by the New York Academy of Sciences, Ad Hoc Animal Research Committee. If the manuscript contains photos or parts of photos of patients, informed consent from each patient should be obtained. Patient's identities and privacy should be carefully protected in the manuscript.

Graphical Abstract

Authors should provide a graphical abstract (a beautifully designed feature figure) to represent the paper aiming to catch the attention and interest of readers. Graphical abstract will be published online in the table of content. The graphical abstract should be colored, and kept within an area of 12 cm (width) x 6 cm (height) or with similar format. Image should have a minimum resolution of 300 dpi and line art 1200dpi. **Note:** Height of the image should be no more than the width. Please avoid putting too much information into the graphical abstract as it occupies only a small space. Authors can provide the graphical abstract in the format of PDF, Word, PowerPoint, jpg, or png, after a manuscript is accepted for publication. For preparing a Professional Graphical Abstract, please click **here**.

Presentation of the article

Main Format

First page of the manuscripts must be properly identified by the title and the name(s) of the author(s). It should be typed in Times New Roman (font sizes: 17pt in capitalization for the title, 10pt for the section headings in the body of the text and the main text, double spaced, in A4 format with 2cm margins (both doc./docx formats). All pages and lines of the main text should be numbered consecutively throughout the manuscript. Abbreviations in the article title are not allowed. Manuscripts should be arranged in the following order:

1. TITLE (brief, attractive and targeted)
2. Name(s) and Affiliation(s) of author(s) (including post code and corresponding Email)
3. ABSTRACT
4. Key words (separate by semicolons; or comma,)
5. Abbreviations (those used throughout the manuscript)
6. INTRODUCTION (clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution)
7. MATERIAL AND METHOD (should be complete enough to allow experiments to be reproduced)
8. RESULTS
9. DISCUSSION
10. CONCLUSION
11. DECLARATIONS (Acknowledgements, Consent to publish, Competing interests, Authors' contributions, and Availability of data etc.)
12. REFERENCES
13. Tables
14. Figures
15. Graphs

Results and Discussion can be presented jointly.
Discussion and Conclusion can be presented jointly.

Article Sections Format

Title should be a brief phrase describing the contents of the paper. The first letter of each word in title should use upper case. The Title Page should include the author(s)'s full names and affiliations, the name of the corresponding author along with phone and e-mail information. Present address (es) of author(s) should appear as a footnote.

Abstract should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The abstract should be 150 to 300 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 8 key words that will provide indexing references should be listed.

Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Material and Method should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail. The ethical approval for using human and animals in the researches should be indicated in this section with a separated title.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the author(s)'s experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. In case of the effectiveness of a particular drug or other substances as inhibitor in biological or biochemical processes, the results should be provided as IC_{50} (half maximal inhibitory concentration) or similar appropriate manner.

Discussion should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

Conclusion should be brief and tight about the importance of the work or suggest the potential applications and extensions. This section should not be similar to the Abstract content.

Declarations including Acknowledgements, Author contribution, Competing interests, Consent to publish, and Availability of data etc.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph forms or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or PowerPoint before pasting in the Microsoft Word manuscript file. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

Declarations

Please ensure that the sections: Ethics (and consent to participate, if any), Acknowledgements, Author contribution, Competing interests, Consent to publish, Availability of data and materials are included at the end of your manuscript in a Declarations section**.**

Acknowledgements

We encourage authors to include an Acknowledgements section. Please acknowledge anyone who contributed towards the study by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include their source(s) of funding. Please also acknowledge anyone who contributed materials essential for the study. Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements. Please list the source(s) of funding for the study, for each author, and for the manuscript preparation in the acknowledgements section. Authors must describe the role of the funding body, if any, in study design; in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication.

Author contribution

For manuscripts with more than one author, JLSB require an Author Contributions section to be placed after the Acknowledgements section. An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; and 3) have given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship. **We suggest the following format/example** (please use initials to refer to each author's contribution): AB carried out the molecular genetic studies, participated in the sequence alignment and drafted the manuscript. JY carried out the immunoassays. MT participated in the sequence alignment. ES participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.
For authors that equally participated in a study please write 'All/Both authors contributed equally to this work.' Contributors who do not meet the criteria for authorship should be listed in an acknowledgements section.

Competing interests

Competing interests that might interfere with the objective presentation of the research findings contained in the manuscript should be declared in a paragraph heading "Competing interests" (after Acknowledgment or Author Contribution sections). Examples of competing interests are ownership of stock in a company, commercial grants, board membership, etc. If there is no competing interest, please use the statement "The authors declare that they have no competing interests.".
Journal of Life Science and Biomedicine adheres to the definition of authorship set up by The International Committee of Medical Journal Editors (ICMJE). According to the ICMJE authorship criteria should be based on 1) substantial contributions to conception and design of, or acquisition of data or analysis and interpretation of data, 2) drafting the article or revising it critically for important intellectual content and 3) final approval of the version to be published. Authors should meet conditions 1, 2 and 3. It is a requirement that all authors have been accredited as appropriate upon submission of the manuscript. Contributors who do not qualify as authors should be mentioned under Acknowledgements.

Consent to publish

Please include a 'Consent for publication section in your manuscript. If your manuscript contains any individual person's data in any form (including individual details, images or videos), consent to publish must be obtained from that person, or in the case of children, their parent or legal guardian. All presentations of case reports must have consent to publish. You can use your institutional consent form or our consent form if you prefer. You should not send the form to us on submission, but we may request to see a copy at any stage (including after publication). If your manuscript does not contain any individual persons data, please state "Not applicable" in this section.

Change in authorship

We do not allow any change in authorship after provisional acceptance. We cannot allow any addition, deletion or change in sequence of author name. We have this policy to prevent the fraud.

Data deposition

Nucleic acid sequences, protein sequences, and atomic coordinates should be deposited in an appropriate database in time for the accession number to be included in the published article. In computational studies where the sequence information is unacceptable for inclusion in databases because of lack of experimental validation, the sequences must be published as an additional file with the article.

REFERENCES

A JLSB reference style for EndNote may be found here. However, we prefer *Vancouver* referencing style that is often used in medicine and the natural sciences. Uniform requirements for manuscripts submitted to Biomedical Journals, published by International Committee of Medical Journal Editors, includes a list with examples of references https://www.nlm.nih.gov/bsd/uniform_requirements.html in the *Vancouver* style.
References should be numbered consecutively and cited in the text by number in square brackets [1, 2] instead of parentheses (and not by author and date). References should not be formatted as footnotes. Avoid putting personal communications and unpublished observations as references. All the cited papers in the text must be listed in References. All the papers in References must be cited in the text. Where available, URLs for the references should be provided.

Examples (at the text, blue highlighted)

Smit [1] ...; Smit and Janak [2]...; Nurai et al. [3] reported that ; ... [1], --- [2, 3], --- [3-7]. The references at the end of this document are in the preferred referencing style. Give all authors' names; do not use "et al." unless there are six authors or more. Use a space after authors' initials. Papers that have not been published should be cited as "unpublished". Papers that have been accepted for publication, but not yet specified for an issue should be cited as "to be published". Papers that have been submitted for publication should be cited as "submitted for publication". Capitalize only the first word in a paper title, except for proper nouns and element symbols. For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation.

Acceptable Examples (at References section)

For Journals:
1. Hasan V, Sri Widodo M and Semedi B. 2015. Oocyte diameter distribution and fecundity of Javaen Barb (*Systomus Orphoides*) at the start of rainy season in Lenteng River, East Java, Indonesia insurance. J. Life Sci Biomed, 5(2): 39-42.
2. Karen KS, Otto CM. 2007. Pregnancy in women with valvular heart disease. Heart. 2007 May; 93(5): 552–558.
3. Doll MA, Salazar-González RA, Bodduluri S, Hein DW. Arylamine N-acetyltransferase 2 genotype-dependent N-acetylation of isoniazid in cryopreserved human hepatocytes. Acta Pharm Sin B, 2017; 7(4):517-522.

For In press manuscripts (maximum 2):
Hasan V, Sri Widodo M and Semedi B. 2015. Oocyte Diamater Distribution and Fecundity of Javaen Barb (Systomus Orphoides) at the Start of Rainy Season in Lenteng River, East Java, Indonesia insurance. In press.

For symposia reports and abstracts:
Cruz EM, Almatar S, Aludul EK and Al-Yaqout A. 2000. Preliminary Studies on the Performance and Feeding Behaviour of Silver Pomfret (Pampus argentens euphrasen) Fingerlings fed with Commercial Feed and Reared in Fibreglass Tanks. Asian Fisheries Society Manila, Philippine 13: 191-199.

For Conference:
Skinner J, Fleener B and Rinchiuso M. 2003. Examining the Relationship between Supervisors and Subordinate Feeling of Empowerment with LMX as A Possible Moderator. 24th Annual Conference for Industrial Organizational Behavior.

For Book:
Russell, Findlay E, 1983. Snake Venom Poisoning, 163, Great Neck, NY: Scholium International. ISBN 0-87936-015-1.

For Web Site:
Bhatti SA and Firkins JT. 2008. http://www.ohioline.osu.edu/sc1156_27.hmtl.

Nomenclature and Abbreviations

Nomenclature should follow that given in NCBI web page and Chemical Abstracts. Standard abbreviations are preferable. If a new abbreviation is used, it should be defined at its first usage. Abbreviations should be presented in one paragraph, in the format: "term: definition". Please separate the items by ";".
E.g. ANN: artificial neural network; CFS: closed form solution; ...
Abbreviations of units should conform with those shown below:

Decilitre	dl	Kilogram	kg
Milligram	mg	hours	h
Micrometer	mm	Minutes	min
Molar	mol/L	Mililitre	ml
Percent	%	.	

Other abbreviations and symbols should follow the recommendations on units, symbols and abbreviations: in "A guide for Biological and Medical Editors and Authors (the Royal Society of Medicine London 1977). Papers that have not been published should be cited as "unpublished". Papers that have been accepted for publication, but not yet specified for an issue should be cited as "to be published". Papers that have been submitted for publication should be cited as "submitted for publication".

Formulae, numbers and symbols

1. Typewritten formulae are preferred. Subscripts and superscripts are important. Check disparities between zero (0) and the letter 0, and between one (1) and the letter I.
2. Describe all symbols immediately after the equation in which they are first used.
3. For simple fractions, use the solidus (/), e.g. 10 /38.
4. Equations should be presented into parentheses on the right-hand side, in tandem.
5. Levels of statistical significance which can be used without further explanations are *P < 0.05, **P < 0.01, and ***P < 0.001.
6. In the English articles, a decimal point should be used instead of a decimal comma.
7. Use Symbol fonts for "±"; "≤" and "≥" (avoid underline).
8. In chemical formulae, valence of ions should be given, e.g. Ca2+ and CO32-, not as Ca++ or CO3.
9. Numbers up to 10 should be written in the text by words. Numbers above 1000 are recommended to be given as 10 powered x.
10. Greek letters should be explained in the margins with their names as follows: Aα - alpha, Bβ - beta, Γγ - gamma, Δδ - delta, Eε - epsilon, Zζ - zeta, Hη - eta, Θθ - theta, Iι - iota, Kκ - kappa, Λλ - lambda, Mμ - mu, Nν - nu, Ξξ - xi, Oo - omicron, Ππ - pi, Pρ - rho, Σσ - sigma, Tτ - tau, Yυ - ipsilon, Φφ - phi, Χχ - chi, Ψψ - psi, Ωω - omega.Please avoid using math equations in Word whenever possible, as they have to be replaced by images in xml full text.

Review/Decisions/Processing/Policy

Firstly, all manuscripts will be checked by Docol©c, a plagiarism finding tool. The received papers with plagiarism rate of more than 30% will be rejected. Manuscripts that are judged to be of insufficient quality or unlikely to be competitive enough for publication will be returned to the authors at the initial stage. The remaining manuscripts go through a single-blind review process by external reviewers selected by section editor of JLSB, who are research workers specializing in the relevant field of study. One unfavourable review means that the paper will not be published and possible decisions are: accept as is, minor revision, major revision, or reject. The corresponding authors should submit back their revisions within 14 days in the case of minor revision, or 30 days in the case of major revision. Manuscripts with significant results are typically published at the highest priority. The editor who received the final revisions from the corresponding authors shall not be hold responsible for any mistakes shown in the final publication.
The submissions will be processed free of charge for invited authors, authors of hot papers, and corresponding authors who are editorial board members of the *Journal of Life Science and Biomedicine*. This journal encourage the academic institutions in low-income countries to publish high quality scientific results, free of charges.

Plagiarism

Manuscripts are screened for plagiarism by Docol©c, before or during publication, and if found (more than 30% duplication limit) they will be rejected at any stage of processing. If we discovered accidental duplicates of published article(s) that are determined to violate our journal publishing ethics guidelines (such as multiple submission, bogus claims of authorship, plagiarism, fraudulent use of data or the like), the article will be "Withdrawn" from SCIENCELINE database. Withdrawn means that the article content (HTML and PDF) is removed and replaced with a HTML page and PDF simply stating that the article has been withdrawn according to the Scienceline Policy on Published Article Withdrawal.

Date of issue

All accepted articles are published bimonthly around 25th of January, March, May, July, September and November, each year in full text on the internet.

The OA policy

Journal of Life Science and Biomedicine is an open access journal which means that all content is freely available without charge to the user or his/her institution. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author. This is in accordance with the *BOAI definition of Open Access*.

Paper Submission Flow

Submission Preparation Checklist

- Authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to the following guidelines.
- The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
- The submission file is in Microsoft Word, RTF, or PDF document file format. Where available, URLs for the references have been provided.
- The text is single-spaced; uses a 12-point font; and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.

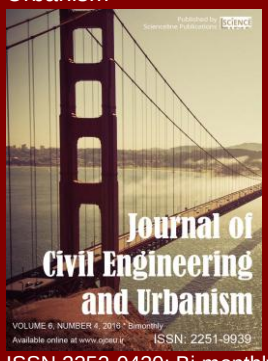
SCIENCELINE PUBLISHING CORPORATION

Scienceline Publication Ltd is a limited liability non-profit non-stock corporation incorporated in Turkey, and also is registered in Iran. Scienceline journals that concurrently belong to many societies, universities and research institutes, publishes internationally peer-reviewed open access articles and believe in sharing of new scientific knowledge and vital research in the fields of life and natural sciences, animal sciences, engineering, art, linguistic, management, social and economic sciences all over the world. Scienceline journals include:

Online Journal of Animal and Feed Research

ISSN 2228-7701; Bi-monthly
View Journal I Editorial Board
Email: editors@ojafr.ir
Submit Online >>

Journal of Civil Engineering and Urbanism



ISSN 2252-0430; Bi-monthly
View Journal I Editorial Board
Email: ojceu@ojceu.ir
Submit Online >>

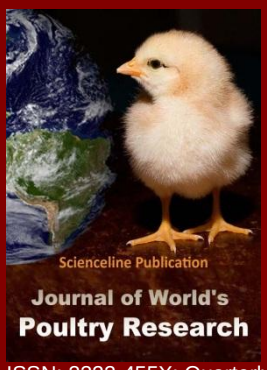
Journal of Life Sciences and Biomedicine

ISSN: 2251-9939; Bi-monthly
View Journal I Editorial Board
Email: editors@jlsb.science-line.com
Submit Online >>

Asian Journal of Medical and Pharmaceutical Researches

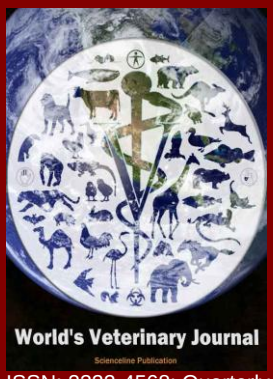
ISSN: 2322-4789; Quarterly
View Journal I Editorial Board
Email: editor@ajmpr.science-line.com
Submit Online >>

Journal of World's Poultry Research



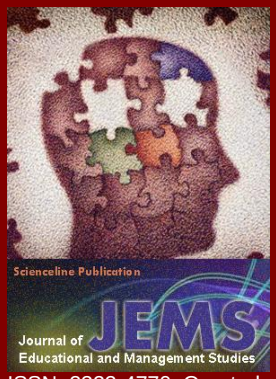
ISSN: 2322-455X; Quarterly
View Journal I Editorial Board
Email: editor@jwpr.science-line.com
Submit Online >>

World's Veterinary Journal



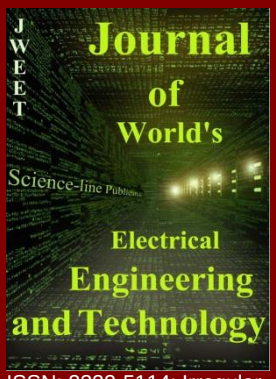
ISSN: 2322-4568; Quarterly
View Journal I Editorial Board
Email: editor@wvj.science-line.com
Submit Online >>

Journal of Educational and Management Studies



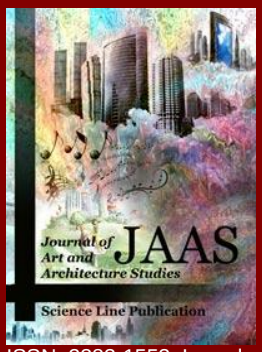
ISSN: 2322-4770; Quarterly
View Journal I Editorial Board
Email: info@jems.science-line.com
Submit Online >>

Journal of World's Electrical Engineering and Technology



ISSN: 2322-5114; Irregular
View Journal I Editorial Board
Email: editor@jweet.science-line.com
Submit Online >>

Journal of Art and Architecture Studies



ISSN: 2383-1553; Irregular
View Journal I Editorial Board
Email: jaas@science-line.com
Submit Online >>

Asian Journal of Social and Economic Sciences

ISSN: 2383-0948; Quarterly
View Journal I Editorial Board
Email: ajses@science-line.com
Submit Online >>

Journal of Applied Business and Finance Researches

ISSN: 2382-9907; Quarterly
View Journal I Editorial Board
Email: jabfr@science-line.com
Submit Online >>

Scientific Journal of Mechanical and Industrial Engineering

ISSN: 2383-0980; Quarterly
View Journal I Editorial Board
Email: sjmie@science-line.com
Submit Online >>