UNIVERSITAS SEBELAS MARET
BIOEDUKASI: JURNAL PENDIDIKAN BIOLOGI
https://jurnal.uns.ac.id/bioedukasi/
1693-265X (Print) | 2549-0605 (Online)

Business Design for Making Organic Native Chicken Feed from Fermentation and Its Implementation in Biology Learning

Amalia Firdaus Yanti[a], Farah Halimah[a], Muhammad Naufal Mu'afa[b], Cindy Puspitasari[b], Ahmad Musthofa Anshori[c], Sajidan[a, 1, *]

[a] Biology Education, Faculty of Teacher Training and Education, Sebelas Maret University, Surakarta-Indonesia
[b] Agribusiness, Faculty of Agriculture, Sebelas Maret University, Surakarta-Indonesia
[c] Livestock Farming, Faculty of Agriculture, Sebelas Maret University, Surakarta-Indonesia
[1] sajidan@fkip.uns.ac.id*
* Corresponding author

Submission : 01/02/2021
Revision : 31/07/2021
Accepted : 31/08/2021

ABSTRACT

Learning in the 21st century demands the increasing of students' creativity in solving problems in the environment. Creating products of economic value by applying the socio-scientific issue (SSI) learning approach can be applied in learning about biotechnology at the high school level. This study aimed to design a learning resource for teaching biotechnology which promoting the issue of SSI and nurturing the entrepreneurship of the student as well. Indonesia has the potential to develop native chicken farming to increase the economy status and people's income, but the productivity of native chickens is still low. To solve the problem, an organic feed based on rice bran and papaya leaves which have high nutritional content were introduced as one of the projects which can be run by high school students. To find the potential of papaya leaves and rice bran, a literature review had been done. The results shows that papaya leaves are rich in protease enzymes so that they can increase the digestibility of amino acids in chickens. Bran contains phytic acid as an antinutrient. The smell of ammonia cannot be separated from the problem of livestock. Production of feed from the fermentation of bacteria *Bacillus subtilis* and Lactobacillus bulgaricus can add phytase enzymes to increase nutrient absorption to accelerate the increase in chicken weight. Fermented feed is also able to inhibit bacteria that break down protein into ammonia so that the smell of feces disappears. Based on these findings, the learning activities for understanding the concepts of biotechnology is need to be further designed.

Keywords: Feed, Papaya Leaves, Phytase, Probiotics, Protease

Introduction

Indonesia has targeted economic independence in 2015-2085 (Ministry of Education and Culture, 2017). One of the efforts to achieve the target is by realizing the fulfillment of the needs of young Human Resources (HR) who have an identity as quality entrepreneurs. This need is based on Kominfo data (2017) where the percentage of unemployment in Indonesia is only 3.1% below Singapore (7%), Malaysia (5%), Thailand (4.5%), Vietnam (3.3%), Japan (10%), China (10%), and South America (12%). The ability of students to become young entrepreneurs must be prepared from an early age to meet these needs in facing various challenges in the future. This is also in accordance with the direction of the Ministry of Research, Technology and Higher Education (2015) which stated that the younger generation must be able to change the paradigm of job seekers to become job creators.

Biology learning in the 21st century demands a learning direction that creates an active, critical, analytical, and creative learning atmosphere in solving a problem (Sudarisman, 2015). Parmin et al., (2015) also stated that the concept of learning biology can essentially link the concept of science with knowledge about the student's environment. It's just that the facts on the ground show that most students have not been able to connect their knowledge to solve problems that exist in their environment (Colucci-Gray & Fraser, 2012). The learning process should be able to create meaning in learning (meaning making) by connecting the student learning process with the environment as a source of finding various kinds of problems (Sadler, 2009).

One way that students can be trained to apply aspects of creativity, be able to carry out various problem-solving innovations in biology learning and be able to create products of economic value is to apply a socio-scientific issues (SSI) learning approach, one of which is biotechnology learning at the secondary school level. Upper (high school). SSI is an issue or problem between scientific knowledge (including biology) and social awareness that creates mental conflicts so that a decision is needed to resolve the problem (Sadler, 2004). Biotechnology is one of the Basic Competencies (KD) of biology subjects in class XII SMA with the demands of the cognitive aspect in the form of "Analyzing the principles of biotechnology and its application as an effort to improve human welfare" and the skill aspect in the form of "Presenting reports on experimental results of applying conventional biotechnology principles. based on the scientific method". The application of biotechnology learning using the SSI approach allows students to practice making biological products that have economic value as a form of solving problems in the environment using the knowledge and biological concepts they already have. In this study, the issue of SSI was focused on how to develop food for native chickens using the indigenous technology, and local sources, i.e. Papaya leaves and rice bran.

Breeders in Indonesia have the potential to develop native chicken farming business because it can increase the economy and people's income. Some people in Indonesia have raised native chickens extensively (traditionally), group scale, or large scale independently (Nataamijaya, 2010). Free-range chicken farming is increasingly in demand by the community because it is easy to adapt to environmental conditions, has a high level of resistance to disease, has high nutritional content, and can be sold at high prices (Anggraini, 2019). The market demand for free-range chicken always increases in line with the rate of population growth (BPS, 2020). BPS data (2020) also shows that the consumption of free-range chicken increases from year to year.

Increased consumption of native chicken meat requires an increase in its supply. It's just that BPS data (2020) shows that the productivity of native chicken meat is still relatively low compared to other types of layer and broiler chickens. Nataamijaya (2010) said that the cause of the low productivity of native chickens is extensive (traditional) rearing of chickens, and in terms of feeding only grass, rice, or leftover vegetables. The impact is that the energy

needs are not met, and the growth of chicken weight is slow. The results of the study also said that the activity of raising livestock was never separated from the problem of the pungent smell of feces (Sarwani et al., 2020). This results in livestock activities being less favored by the surrounding community.

Increasing the productivity of native chickens is needed to meet the increasing needs. On the other hand, there is a tendency for people to improve the quality of healthy life with the increasing back to nature movement (Novandari, 2011). Based on this, the business of making organic free-range chicken feed is a prospective business to be developed because it will help solve the problem of free-range chicken productivity while at the same time increasing the family economy.

Methods

This study used the literature review (LR) method to get information about the potential to develop a native chicken organic feed, which will be applied as project-based activities in the topic of biotechnology at high school. The literature used were research articles published in the scientific journals, official web data sources, and books. A literature review method that reveals, assesses, and interprets findings on a previous research topic, to answer predetermined research questions. The research questions are what are the ingredients of papaya leaves and rice bran which are potential as chicken feed? what the role of probiotics, as one of biotechnology issues should be considered in chicken feed? what are the mechanism of bacteria on reducing the ammonia odor of chicken stool? what are the role of protease an phytase enzyme on chicken development? and what are the potential of fermented native chicken feed as bio entrepreneur product?

Results and Discussion

Chicken farms with intensive systems that in fact use antibiotics in feed, use disinfectants that are not environmentally friendly, use synthetic drugs and so on that can have a negative impact on human health and trigger various diseases make chicken consumers restless. Currently, consumers have been thinking about the negative impact of consuming chicken products produced by intensive cultivation using inorganic feed. Supported by global issues regarding animal welfare, back to nature and other additives in food that can interfere with human health, consumers are more careful in choosing food quality (Abbas, 2011). Therefore, the existence of an organic chicken farm will meet consumer needs regarding food quality and overcome the negative impact of consuming intensively farmed chicken products using inorganic feed. Organic chicken is supported by the provision of quality feed, such as the manufacture of organic-based feed with the addition of probiotics that can improve feed quality (Nurhapsa et al., 2017).

Rice Bran and Papaya Leaves as Raw Materials for Organic Native Chicken Feed

Supartini & Fitasari (2011) stated that rice bran can improve the nutritional quality of native chickens because it is rich in carbohydrates, crude protein, and crude fiber. The nutrients in rice bran can be used to support the growth of livestock so that it can increase the body weight of chickens. Rice bran is also one of the useful rice wastes because it contains most of the endosperm so that it can be used as animal feed.

Papaya leaves contain proteolytic enzymes, papain enzymes, saponins, glycosides, sucrose, and dextrose which can be used to improve the digestive process of poultry (Hartini & Mursyida, 2019). Yadava et al., 1990 also stated that the content of papaya leaves is mostly in the form of proteolytic enzymes which include papain enzymes, chymopapain A and B,

and papaya peptidase. Papain enzyme which is owned by papaya leaves can function as a compound that facilitates the digestive process, for example the breakdown of protein which greatly determines the growth rate of poultry (Santoso & Fenita, 2015). (Hartini & Mursyida, 2019) also mentioned that papaya leaves are rich in protein, proteolytic enzymes and papain, which can improve the digestive process of poultry. Papaya leaves are good for use as feed because they can improve poultry health, appetite, and egg yolk color (Muharlien & Nurgiartiningsih, 2015).

The use of bran and papaya leaves is very good to be used as an alternative to the use of local raw materials in the manufacture of animal feed because they are organic-based which has a lot of content to support increased productivity of native chickens. It's just that the use of animal feed directly, especially on bran will have a bad impact because it still contains a lot of phytic acid as an anti-nutritional factor (Rochmawati et al., 2016). Yanuarto et al., (2016) mention anti-nutrients are substances that can directly or indirectly interfere with the health of livestock, one of which is the level of nutrient digestibility in animals. Sajidan et al., (2004) mentioned the presence of anti-nutritional substances in livestock can reduce nutrient intake and absorption. Akande (2010) also mentions that the presence of these anti-nutritional substances can make livestock experience health problems and various other negative side effects. These antinutrients can bind to magnesium (Mg), calcium (Ca), sodium (Na), iron (Fe), zinc (Zn), potassium (K) and in some cases are also chelates on proteins and carbohydrates. ., (2000). Therefore, anti-nutritional substances in animal feed can reduce the productivity of native chickens.

Efforts that can be made to optimize rice bran and papaya leaves as quality organic animal feed are by using the bacteria Bacillus subtilis and Laactobacillus bulgaricus as probiotic ingredients that are processed through a fermentation process. The existence of a fermentation process using both bacteria can increase the nutritional content of the feed and solve the phytic acid in the bran (Supartini & Fitasari, 2011). A mixture of rice bran and papaya leaves with the addition of probiotics is combined to improve protein digestion and also eliminate the smell of ammonia in native chickens.

The Role of Probiotics in the Making of Free-range Chicken Feed

WHO (2001) in Purkan et al., (2017) states that probiotics in certain doses have many benefits in the health sector. This also applies to the livestock sector (Kompiang, 2009). Fuller (1989) states that probiotics are derived from live bacteria and are beneficial animal feed supplements. The activity of probiotics in the digestion of livestock can make the balance of microflora in the intestines increase due to the presence of beneficial microbes that push pathogenic microbes out of the digestive tract. Fuller (1992) also states that the effectiveness of probiotic activity depends on the ability to survive in certain environmental conditions and in certain packaging. Riza et al., (2015) stated that probiotics that can survive for a long time and are packaged into industrial scale in field conditions are effective probiotics to use. The criteria for bacteria as probiotics are said to be beneficial according to Widiyaningsih (2011) including being able to carry out the process of fermenting oligosaccharide sugar groups quickly, replicating so that they can produce many colonies, surviving in an acidic environment in the digestive tract, being stable during fermentation, and having a positive effect on the host so that profitable. Various kinds of probiotics including fungi and bacteria. Bacteria are included in living things that have the highest probiotic properties (Raja & Arunachalam, 2011). Bacteria that are widely known and have been marketed for example from the *Lactobacillus sp* and *Bacillus sp*.

The Mechanism of Bacterial Action in Reducing Ammonia Odor in Chicken Stool

Charles (1991) stated that ammonia is a gas resulting from the activity of microorganisms in feces which is a by-product of the decomposition of nitrogenous waste materials in excreta (uric acid, unabsorbed protein, amino acids, and other NPN (Non Protein Nitrogen) compounds). The smell of ammonia in livestock feces causes an unpleasant odor so that if it is excessive it can interfere with the health, productivity level, and performance of livestock. One of the negative impacts caused by excess levels of ammonia is to stimulate News Castle Disease (ND) in (Riza et al., 2015). Therefore, it is important to control ammonia levels in order to maintain healthy conditions for both livestock and the environment around the cage.

Manin (2010) in (Riza et al., 2015) states that the use of bacteria Bacillus subtilis and Lactobacillus bulgaricus as probiotics has the potential to reduce the smell of ammonia in poultry feces and can significantly reduce ammonia levels from feces. The use of bacterial activity has an impact on decreasing the pH of chicken feces which works by producing acid. The two bacteria will inhibit the activity of protein-decomposing microbes so that the breakdown of protein into ammonia is reduced (Riza et al., 2015). Bacteria from the genus Bacillus themselves are able to inhibit the conversion of uric acid into ammonia by utilizing uric acid itself as a nutrient.

The mechanism of bacteria that can reduce ammonia levels works by producing antibiotics. These antibiotics will suppress the growth of gram-negative bacteria as harmful bacteria (pathogens). Pathogenic bacteria that have been suppressed will experience a low growth rate. This causes the production of the enzyme urease (which converts uric acid to ammonia) is also low so that ammonia levels will decrease. The reduction in ammonia levels occurs because the bacteria *Bacillus subtilis* and *Lactobacillus bulgaricus* produce acid, causing a decrease in pH in the digestive tract of chickens and causing gram-negative bacteria to die and even not grow anymore. This makes the levels of H+ ions in feces available quite a lot so that the binding of ammonia (NH3) to ammonium (NH4+) increases (Riza et al., 2015). Therefore, the ammonia released in the environment will also be reduced. The decrease in stool pH greatly determines the conversion of the balance of ammonia to ammonium. Ammonium is more soluble in water so the evaporation process is slower than ammonia. The ammonia that is still formed will be bound with ammonium so that the feces are odorless.

The Mechanism of Protease and Phytase Enzymes in Accelerating the Increase in Chicken Weight

Lismawati et al., (2017) stated that the papain enzyme found in the fruit, stem, and leaves of papaya is a protease enzyme, working by breaking peptide bonds in proteins by hydrolyzing them. The mechanism of increasing chicken weight begins with a protein hydrolysis process that will produce a hydroxylate. This hydrosylate contains low molecular weight peptides and free amino acids. Fox et al. (1982) stated that the hydroxylate product produced from the hydrolysis process has a high ability to dissolve in water, has good emulsion capacity, grows large, and can be easily absorbed by the body. The papain enzyme as a protease enzyme can also quickly cut peptide bonds in proteins so as to produce amino acids that are absorbed by the body optimally. Maximizing the absorption of amino acids in the chicken body causes maximum absorption of nutrients in the chicken body, reducing wasted nutrients. The protease enzyme helps the maximum absorption of amino acids as a supporting factor for chicken growth so that the weight of the chicken can increase quickly and the energy needs of the chicken are met. In addition, the presence of the papain enzyme also increases the quality of the meat because it can increase the tenderness of free-range

chicken which is usually less tender when eaten (Fitasari, 2012). the inner bonding woven fibers will decrease rapidly (Lewrie, 2003). When this process takes place, hydrolysis of collagen and myofibrils occurs. As a result of the hydrolysis process, the fiber bonds in the meat are lost and the shorter fiber fragments are broken. This will make chicken meat more tender when using animal feed that contains the papain enzyme in it (Lismawati et al., 2017). Supartini & Fitasari (2011) stated that fermentation using bacteria can increase nutrient content by breaking down phytic acid in rice bran so as to accelerate the digestive process in chickens. The phytic acid can be broken down and reduced by adding the phytase enzyme (Sajidan et al., 2004). One of the bacteria that contains phytase is from the Bacillus sp. Many bacteria from this group are found and have now been isolated, sequenced, and expressed, one of which is often found, namely Bacillus subtilis (Keruvuo et al., 1998). The use of fermented animal feed can use microbes such as Bacillus subtilis bacteria which contain phytase which can replace pure phytase which has an expensive price so that it can reduce feed production costs. On the other hand, manufacture by fermentation process will also support the addition of phytase enzymes in animal feed. Fermentation is one of the effective methods used because it is done traditionally at an affordable price. Changes in livestock products using fermented feed using bacteria are an increase in the quality of texture, taste, aroma, consistency, and a reduction in nutrient absorption in feed (Yanuarto et al., 2016). The phytase enzyme is able to break down phytic acid by catalyzing the hydrolysis reaction of the phosphoester bond in phytic acid (mio-inositol hexaxisphosphate). The existence of these events produces inorganic phosphate and phosphate esters (Wyss et al., 1999). Because native chickens do not have a high phytase content in their digestive tract, the role of bacteria and the fermentation process in making native chicken feed is very important to accelerate the increase in chicken weight so that chicken productivity also increases.

Potential of Fermented Native Chicken Feed as a Bioentrepreneur Product

The manufacture of organic free-range chicken feed made from rice bran and papaya leaves fermented with *Bacillus subtilis* and *Lactobacillus bulgaricus* bacteria has more advantages than non-fermented organic feed, such as being able to increase chicken body weight quickly and eliminate the smell of the resulting feces. The presence of the papain enzyme also makes the quality of the meat increase because it can increase the tenderness of native chicken meat which is usually less tender when eaten (Fitasari, 2012). The business of making organic free-range chicken feed has the potential to be developed as a result of biological products. This business potential is supported by an increase in the consumption of free-range chicken in Indonesia. The development of free-range chicken meat consumption in Indonesia is presented in Table 1.

Table 1. Consumption of Kampung Chicken in Indonesia

Year	**2013**	**2014**	**2015**	**2016**	**2017**
Kg/Capita/Year	0.47	0.52	0.63	0.63	0.78

(BPS, 2020)

This organic free-range chicken feed also has the potential to be developed because it is in line with the development of consumer lifestyles towards organic food. This effort is in line with a healthy lifestyle that has been institutionalized internationally by requiring guarantees that agricultural products must be safe for consumption (food safety attributes), high nutritional content (nutritional attributes), and environmentally friendly (eco-labelling attributes). Consumer preferences like this cause the world's demand for organic agricultural products to increase rapidly (Silitonga & Salman, 2014). This is a market opportunity for free-range chicken feed as a bio-entrepreneur product.

Analyzed in terms of the marketing area, Central Java and East Java are potential areas for marketing the business plan for making organic free-range chicken feed because these two provinces have the largest free-range chicken populations on the island of Java, even in Indonesia. Data on the population of native chickens in Java is presented in Figure 1.

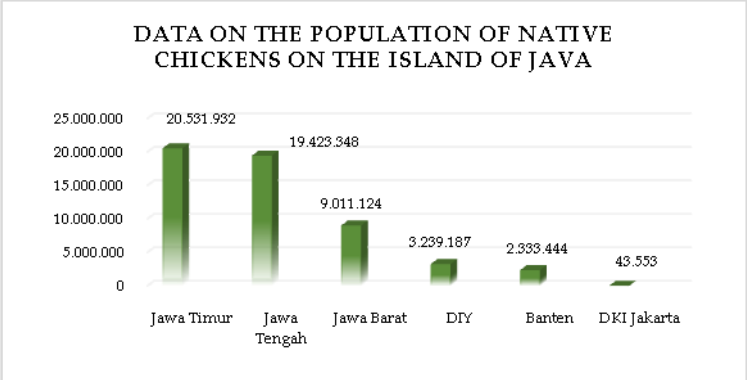

FIGURE 1. Population Data of Kampung Chicken in Java Island

Making organic free-range chicken feed made from rice bran and papaya leaves fermented with Bacillus subtilis and Lactobacillus bulgaricus bacteria is one application of biology learning that can be applied in entrepreneurship-based biotechnology learning. The existence of organic free-range chicken feed which is one of the biological products strongly applies the SSI approach. Through this application example, students will be trained in applying problem-based biology learning in the environment and solving them using the knowledge they have.

Students can identify problems in the environment such as the background of making fermented free-range chicken feed which includes the low productivity of native chickens due to lack of chicken nutrition, the price of quality feed in Indonesia is still expensive, and the problem of the smell of manure that is never separated from livestock problems. The existing problems spur students' creativity in creating animal feed products based on biology, namely by creating products that can increase the productivity of native chickens through increasing weight and being able to eliminate the smell of feces as an effort to reduce negative externalities in society. The habit of making environmental-based biological products also has its own value to overcome the problems that exist in society. Everything that is tackling environmental problems will always be needed because every era will never be free from problems so that the products produced will definitely have economic value. The application of learning using the SSI approach allows students to practice applying the knowledge they have learned in solving problems that occur in the environment using biological concepts and developing students' paradigms to become bioentrepreneurs. This paradigm will be formed if students are always encouraged to do entrepreneurial-based learning so that the desire to become job creators becomes greater and can reduce unemployment in Indonesia.

Conclusion

Making organic free-range chicken feed made from rice bran and papaya leaves fermented with *Bacillus subtilis* and *Lactobacillus bulgaricus* bacteria is one of the bio entrepreneurships learning applications that can be applied in high school biotechnology learning by applying the socio-scientific issues (SSI) learning approach. The production of fermented free-range chicken feed has the advantage of accelerating the increase in weight of free-range chickens with the support of protease and phytase enzyme activities and eliminating the smell of

ammonia in chickens by inhibiting the activity of microbial decomposers of protein into ammonia. Through this application example, students will be familiar with applying problem-based biology learning in the environment and solving them using the knowledge they have.

Acknowledgment

This study is funded by the "Student Creativity Program (PKM)" with contract number 1686/E2/TU/2020, Ministry of Education and Culture, Republic of Indonesia.

References

Abbas, M. (2011). Unggas Organik: Peternakan Ayam Masa Depan. Jurnal Peternakan Indonesia, 107-119.

Akande, K. E. (2010). Major Antinutrients Found in Plant Protein Sources: Their Effect on Nutrition. Pakistan J. Nutr, 9(8).

Anggraini, A. D. (2019). Efektifitas Penambahan Tepung Temulawak dalam Ransum sebagai Upaya Peningkatan Produktifitas Ayam Kampung Super. Jurnal Sain Peternakan Indonesia, 222-227.

Badan Pusat Statistik. 2020. Konsumsi Daging Ayam Per Kapita. URL: https://www.bps.go.id/publication/2019/06/25/bbf8ec1716fb4583687996c3/kajian-konsumsi-bahan-pokok-tahun-2017.html. Diakses pada 19 Januari 2021.

BPS. 2020. Peternakan dalam Angka 2020, Badan Pusat Statistik. URL: https://www.bps.go.id/publication/2020/06/10/93c6d3265760176e2a87c8cf/peternakan-dalam-angka-2020.html. Diakses tanggal 19 Januari 2021.

Charles, R. T., & Hariono, B. (1991). Pencemaran Lingkungan Oleh Limbah Peternakan dan Pengelolaannya. Bull. FKG-UGM, 71-75.

Colucci-Gray, L., & Fraser, C. (2012). From Science as 'Context' to Science as 'Interpretive Key': Experiences and Reflections from A Sciences Couse in Teacher Education. Ethnography and Education, 175-195.

Fitasari, E. (2012). Penggunaan Enzim Papain dalam Pakan Terhadap Karakteristik Usus dan Penampilan Produksi Ayam Pedaging. Buana sains, 7-16.

Fuller, R. (1992). History and Development of Probiotis. In: Probiotics The Scientific Basis. FULLER. (Ed). London, New York, Tokyo, Melbourne, Madras: Chapman & Hall.

Hartini, S., & Mursyida, E. (2019). Efektivitas Pemberian Ekstrak Daun Pepaya (Carica papaya L) Terhadap Pertumbuhan Bakteri Escherichia coli dan Shigella dysenteriae. Jurnal Analis Kesehatan Klinikal Sains, 8-17.

Kementerian Komunikasi dan Informatika Republik Indonesia. 2017. Peluang Besar Jadi Pengusaha di Era Digital. https://kominfo.go.id/content/detail/9503/peluang-besar-jadi-pengusaha-di-era-digital/0/berita. Diakses tanggal 19 Januari 2021.

Kementerian Pendidikan dan Kebudayaan. (2017). Prakarya dan Kewirausahaan. Jakarta: Pusat Kurikululum dan Perbukuan, Balitbang, Kemendikbud.

Kementerian Riset, Teknologi, dan Pendidikan Tinggi. 2015. Pedoman Program Mahasiswa Wirausaha (PMW). Jakarta: Direktoral Jenderal Pembelajaran dan Kemahasiswaan Kementerian Riset, Teknologi, dan Pendidikan Tinggi.

Kompiang, I. (2009). Pemanfaatan Mikroorganisme sebagai Probiotik untuk Meningkatkan Produksi Ternak Unggas di Indonesia. Bogor: Pengembangan Inovasi Pertanian.

Lismawati, Razali, & Ferasyi, T. R. (2017). Daya Pengempukan Ekstrak Daun Pepaya (Carica papaya) dan Ekstrak Daun Buah Nanas (Ananas comosus) terhadap Daging Paha Ayam Kampung Dinilai dari Daya Putus dan Gambaran Mikroskopis. Imvet, 788-793.

Muharlien, M., & Nurgiartiningsih. (2015). Pemanfaatan Limbah Daun Pepaya dalam Bentuk Tepung dan Jus untuk Meningkatkan Performans Produksi Ayam Arab. Reseacrh Journal of Life Science, 93-100.

Nataamijaya, A. G. (2010). Pengembangan Potensi Ayam Lokal untuk Menunjang Peningkatan Kesejahteraan Petani. Jurnal Litbang Pertanian, 131-138.

Novandari, W. (2011). Analisis Motif Pembelian dan Profil Perilaku 'Green Product Customer' (Studi pada Konsumen Produk Pangan Organik di Purwokerto). Jurnal JEBA, 9-16.

Nurhapsa, Yusriadi, & Nurhaedah. (2017). Campuran Pakan Herbal Untuk Ternak Ayam Kampung. Jurnal Equilibrium, 6(1).

Parmin, Sajidan, Ashadi, & Sutikno. (2015). Skill of Prospective Teacher in Integrating The Concept Science with Local Wisdom Model. Jurnal Pendidikan Ipa Indonesia, 4(2), 120-126.

Purkan, P., Laila, N., & Sumarsih, S. (2017). Lactobacillus bulgaricus sebagai Probiotik Guna Peningkatan Kualitas Ampas Tahu untuk Pakan Cacing Tanah. Jurnal Kimia Riset, 2(1), 1-9.

Raja, B. R., & Arunachalam. (2011). Maret Potential for Probiotic Nutritional Supplements in India. African Journal of Bussiness Management, 5(14), 5418-5423.

Riza, H., Wizna, Rizal, Y., & Yusrizal. (2015). Peran Probiotik dalam Menurunkan Amonia Feses Unggas. Jurnal Peternakan Indonesia, 17(1), 19-26.

Rochmawati, A. P., Arief, M., & Prayogo. (2016). Penambahan Enzim Fitase pada Pakan Buatan terhadap Nilai Kecernaan Protein dan Energi Ikan Baung (Mystus menurus) dengan Teknik Pembedahan. Journal of Aquaculture and Fish Health, 6(1), 1-7.

Sadler, T. D. (2004). Informal Reasoning Regarding Sosioscientific Issues: A Critical Review of Research. Journal of Research in Science Teaching, 41(5), 513-536.

Sadler, T. D. (2009). Situated Learning in Science Education: Sosio-scientific Issues as Contexts for Practice. Studies in Science Education, 45(1), 1-42.

Sajidan, Nuhriwangsa, A. M., & Ratriyanto, A. (2004). Pengaruh Bakteri Penghasil Fitase pada Pakan Campuran Wheat Pollard Terhadap Performan Ayam Broiler. Buletin Peternakan, 28(3), 114-121.

Santoso, U., & Fenita, Y. (2015). Pengaruh Pemberian Tepung Daun Pepaya (Carica papaya) terhadap Kadar Protein dan Lemak pada Telur Puyuh. Jurnal Sain Peternakan Indonesia, 10(2), 71-76.

Sarwani, Nardi, S., Nurzaman, E., Marjohan, M., & Hamsinah. (2020). Penerapan Ilmu Manajemen dalam Pengembangan Agroindustri Biogas dari Limbah Kotoran Sapi yang Berdampak pada Kesejahtraan Masyarakat Desa Sindanglaya Kec. Tanjungsiang, Kab. Subang. Jurnal Abadi Masyarakat HUMANIS, 1(2), 75-86.

Selle, P. H., V. Ravindran, R. C., & Bryden, W. L. (2000). Phytate and Phytase: Consequences for Protein Utilization. Nutr. Res. Rev, 13(2), 255-278.

Silitonga, J., & Salman. (2014). Analisis Permintaan Konsumen Terhadap Sayuran Organik di Pasar Modern Kota Pekanbaru. Dinamika Pertanian, 29(1),79–86.

Sudarisman, S. (2015). Memahami Hakikat dan Karakteristik Pembelajaran Biologi dalam Upaya Menjawab Tantangan Abad 21 serta Optimalisasi Implementasi Kurikulum 2013. Jurnal Florea, 02(1), 29-35.

Supartini, N., & Fitasari, E. (2011). Penggunaan Bekatul Fermentasi Aspergillus Niger Dalam Pakan Terhadap Karakteristik Organ Dalam Ayam Pedaging. Buana Sains, 11(2), 127–136.

Widiyaningsih, E. N. (2011). Peran Probiotik untuk Kesehatan. Jurnal Kesehatan, 4(1), 14-20.

Wyss, M., Brugger, R., Kronenberger, A., Remmy, R., Fimbel, R., Oesterhelt, G., Loon, V. (1999). Bi Chemical Characterization of Fungal Phytases (mio-inositol hexakisphosphate phoshohidrolasea). Chatalyzed Properties, Apllied and Environmental Microbiology, 65, 367-373.

Yadava, U. L., A. Janice, B., & McGary, D. (1990). Papaya: A Potential Annual Crop Under MiddleGeorgia Conditions. In: J. Janick and J. E. Simons (Eds.), Advances in New Crops. Portland: Timber Press.