

# SAJAAS

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# SAJAAS



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## Reverse Migration during Pandemic: Narratives on the Quest for Survival of Returned Migrant Workers in the Philippines

Astilla, Rebecca L.\* and Marcos, Claudine\*

### Abstract

According to the International Migration Report of 2019 conducted by the United Nations, about 272 million people are estimated to be international migrants worldwide in 2019. Among the countries of Eastern and South-Eastern Asia, the largest sending countries of the region during 2000-2020 were China, Philippines, Myanmar, and Indonesia, while the largest receiving countries were Japan, Singapore, and Malaysia. Existing research on return migration and reintegration have shown how countries in Southeast Asia including Philippines are dealing with the return of migrant workers using governments' efforts to reintegrate returnees into their community. However, while programs for returning migrant workers are evident in different studies, the issue of its efficacy during the ongoing health crisis remains a mystery. Using a narrative research design under qualitative research methodology, the researchers conducted in-depth interview from seven returned migrants. The study aims to explore the experiences of return migrant workers during this current and ongoing global pandemic. Specifically, it answer the questions such as the challenges encountered by OFWs during repatriation and upon their arrival in the country and the government support towards returned migrants. From the narratives gathered on the participants, the study found a relevant connection between the pandemic and the livelihood capability, emotional well-being, as well as problematic social relations due to the stigma attached to migrant workers. Still, despite these challenges, having a positive outlook and hope help the returned migrants to navigate though their problems and current scenarios. During the repatriation, the study also highlighted rigorous process experienced by migrant workers before and upon their return in the country mandated by the Philippine Government to restrain Coronavirus disease (COVID-19) transmission. In terms of reintegration, various government programs are also identified to address the needs of migrant workers. Nevertheless, the study found out that there are factors that affect successful implementation of government programs which include uninformed and misinformed returnees, lack of information dissemination, and limited funds of the government.

**Keywords:** *migration, COVID-19 pandemic, returned migrants, reintegration policy, livelihood, emotional/ psychological effect*

## Introduction

It has been over a year now since the first case of '*pneumonia of unknown cause*,' which was later known as SARS-COV 2 virus infection, was first identified in Wuhan, China (WHO, 2020). This outbreak quickly escalated, and on March 11, 2020, the WHO declared the novel coronavirus (COVID 19) outbreak as a global pandemic (Cucinotta & Vanelli, 2020). However, more than just a public health concern, COVID 19 Pandemic also has severe economic repercussions. In many countries, massive repatriation of migrant workers has been witnessed. Many of these migrants were caught up in a travel ban and lack of transportation due to the existing quarantine regulations, while some had lost their jobs and livelihood (Asis, 2020; Bernal, 2020; İcduygu, 2020). In the Philippines, the number of Overseas Filipino Workers (OFWs) who worked abroad between the periods of April to September 2019 was estimated to be at 2.2 million based on the results of the PSA 2019 Survey on Overseas Filipinos. About 96.8 percent of the total OFWs during the said period were Overseas Contract Employees (OCWs) or those with existing work contracts while the remaining 3.2 percent worked even without a contract overseas. Among these numbers, the Department of Foreign Affairs (DFA) reported that about 327,511 overseas Filipinos had been repatriated in 2020 (DFA, 2021). Of the overall figures, 231,537 or 70.7 percent are land-based returnees, coming from at least 90 countries worldwide and the remaining 29.3%, or 95,974 include seafarers.

This paper explores narratives about the lives of returned migrant workers during this current and ongoing global pandemic focusing on the Philippines as the largest labor sending country in Southeast Asia (Hugo, 2012). Specifically, it will answer the research questions below:

1. What are the challenges faced by the OFWs during the repatriation and upon their arrival in the country?
2. How did COVID-19 Pandemic affect the lives of returned migrant workers?
3. What government support has been done to mitigate the queries of OFWs?

The effects of migration on development have been strongly acknowledged and discussed on an ongoing basis, especially concerning the magnitude of remittances to reduce poverty. However, not many studies are available to discuss return migration (Wickramasekara, 2019) especially in response towards the ongoing health crisis. This study focuses on this literature gap. The study will be a significant addition in understanding the connection of return migration and COVID-19 in the Philippines. It will also be beneficial to policymakers because reintegration programs are often initiated by the government. The attempt to link reintegration policies with COVID-19 Pandemic is a vital endeavor to address what will happen next after migrant workers return to their country. As per limitation, the study will focus only on the repatriation, challenges of returned migrants, and identifying reintegration programs in mitigating repercussions brought by COVID-19. It will not delve into an in-depth analysis of each government policy and will not include other sectors affected by the pandemic.

## Materials and Methods

The study utilized a narrative research design under qualitative research methodology which focuses on explaining the life and experiences of returned migrant workers in the Philippines due to the effect of the COVID-19 virus. The study was conducted in the province of Bulacan from December 2020 to January 2021. All participants are at least 1-year international migrant workers and returned to the

Philippines during the pandemic. In general, seven returned OFWs were selected through purposive sampling based on the objectives of the research. Four of them are male, while three are female belonging in the age bracket of 24-41 covering different occupations and returned to the country from May 2020 to November 2020. However, given the sample size of participants, the results of this study cannot be generalized as an embodiment of all experiences of returned migrant workers in the Philippines. Nonetheless, the study aim to pave way in deeper understanding of repatriation during the pandemic. The data are collected through phone calls and actual interviews using semi-structured interview questions. After seeking consent from the participants, all discussions were recorded and transcribed by the researchers. The accounts of returned migrant workers were analyzed, retold, and organized through identified themes or narrative segments. To present the patterns and meanings behind the experiences of repatriated OFWs, the study uses a thematic approach. According to King, as cited by Nowell *et al.* (2017), thematic analysis is a useful method examining the perspectives of different research participants, highlighting similarities and differences, and generating unanticipated insights.

## **Results and Discussion**

### **Challenges Faced by OFWs during Repatriation and upon Arrival to the Country**

The sudden cessation of the world brought by the pandemic resulted in disruptions on the lives of many people around the world. Among those who are severely affected are the OFWs (Overseas Filipino Workers) who are left with no choice but to end the journey that they started abroad. According to Liao (2020), repatriation during the COVID-19 pandemic is much more complicated compared to other repatriation causes. The process of coming back home is an exhausting cycle. An article written by Venuz Zoleta in 2020 elaborated the repatriation process that migrant workers should follow upon their return in the Philippines. The steps include securing a repatriation flight by inquiring with the Philippine Embassy, booking hotel facilities accredited by DOH, and staying in quarantine facilities upon their return while waiting for the swab test result. Also, under the command of IATF, all returning Filipino migrants, regardless of transportation mode, are required to undergo a 14-day quarantine (PCG, 2020). According to the participants in the study, the strict health protocols in the repatriation process does not just start upon the arrival of the returned migrants. Some of them are already quarantined abroad, like Participant 01, who had spent five days in a quarantine facility in Equatorial Guinea, West Africa, before returning home. To ensure that OFWs will get proper assistance and accommodation when they arrive in the country, participants are also instructed to fill out online registration forms to different Philippine agencies such as e-CIF (Electronic Case Investigation Form from Philippine Red Cross) and OASIS (OFW Assistance Information System) to be eligible for the benefits from OWWA (Overseas Workers Welfare Administration) which include payment for airlines, swab test, and hotel accommodation. Nevertheless, this lengthy migration process is not just exclusive in the Philippines. In ASEAN, all countries established quarantine centers and guidelines in accommodating returning migrants in accordance with health protocols (ILO, 2021). For instance, Cambodia mandated a 14-day quarantine and established an estimated 75 state-supervised quarantine facilities while across Myanmar, over 10,000 quarantine facilities were established (ILO, 2021). As the second country with the highest number of migrant workers in Southeast Asia after the Philippines, Indonesian government also mandated that international migrant workers as well as foreign nationals entering their country to be treated in accordance with safety guidelines. Hence, returning migrants must undergo the COVID-19 screening procedure upon arrival which include interview, temperature check, oxygen saturation check as well as rapid test and/or PCR



examination. When symptoms like coughing and high fever are detected, they will be referred in a government-approved health facility in the local area by applying the infectious disease referral protocol (Anaf, Ibnu, Romdiati, & Noveria, 2022; Indonesia.go.id, 2020).

However, despite the meticulous policies set for returning migrants, there are still issues that need to be addressed. In terms of the length of stay in quarantine facilities, the study noted that though there is a 14-days quarantine protocol in the Philippines, returned OFWs experienced different quarantine periods due to the prolonged swab test result. The failure to provide immediate swab test results of returned OFWs lead to inadequacy of quarantine centers. As emphasized by the participants, the government is having a difficulty to cope up with the huge number of returning migrants due to the unavailability of isolation facilities. Some also experienced staying in their service bus for almost twenty-four hours just because hotels that are serving as quarantine facilities are fully occupied. Regarding the health guidelines, all the participants stressed the need to observe basic protocols such as wearing of face mask, face shield, and staying in their respective hotel rooms. Unfortunately, husband and wife, Participant 04 & Participant 05 emphasized their frustration by the lack of physical distance on the airlines before arriving in their designated quarantine facility.

Participant 04:

*“Bale sa airlines, sabi may social distancing pero wala din. Bale pagdating namin ng airport, natulog kami sa bus kasi walang available na hotel. 24 hours kami nasa bus kasi nga puno daw yung mga hotel tapos ayun nga sa dami namin doon eh lahat nag rereklamo (It was said that there will be social distancing in airlines but there is none. When we arrived at the airport, we slept on the bus for 24 hours because the hotels were full. Because of the situation, everyone is complaining.)”*

Aside from the difficulties stated above, further problems in terms of transportation and drop off are also mentioned. Although transportation restriction to majority of Philippine vehicles was lifted on June 24, 2020 after almost four months of strict lockdown due to the pandemic, Martin Delgra, LTFRB Chief, announced that only 8% out of 74,000 jeepneys are back to the road due to the strict reopening of only 49 out of 900 existing jeepney routes in Manila as of July 13, 2020 (Beltran, 2020). Even if the returned OFWs can somehow managed to find way to go back to their hometowns, there are still reports that some LGUs (Local Government Units) barred the return of OFWs for fear that they might be carriers of the coronavirus (Asis, 2020; Tomacruz, 2020). As a response, the Philippine government strictly warned LGUs to accept returning migrants to avoid legal ramifications (“DILG to issue show cause order”, 2020).

Despite the issues faced in repatriation, it is also worthy to note the positive effort made by ASEAN to discuss support for migrant workers through the 13th ASEAN Forum on Migrant Labour (AFML) hosted by Viet Nam. Some of the recommendations discussed are ensuring accessibility in health care, income support, and social protection; strengthening migrant workers’ return and reintegration programs with adequate resources; maximizing technology in processing migrant workers’ immigration and employment documents to limit physical contact; and increasing collaboration of different sectors to strengthen national policy framework for protection of migrant workers in time of pandemic (ILO, 2020). In line with this, Asis (2020) has commended the Philippines for its satisfactory practices in dealing with repatriated OFWs which include establishing partnership between Philippine government institutions and recruitment agencies, utilizing online platforms to provide information and support to repatriated Filipino migrant

workers, and developing the OFW Assistance Information System as a tracking structure to facilitate orderly repatriation and assistance to the vast number of returning OFWs.

### **Effects of Pandemic on the Lives of Returned Migrant Workers: Stories of Hope and Struggle amidst the Pandemic**

COVID 19 has huge political, health, social, and economic repercussions around the world including the Philippines. Among the most vulnerable sectors in the country affected by economic downfall are the OFWs abroad who are forced to return to the country. The narratives below answer the second research question of the study which focuses on determining the extent of the Pandemic's effect on the lives of migrant workers upon their arrival.

#### ***Father's Grief Behind the Luxury***

The sacrifice in West Africa by Participant 01 ended unexpectedly in 3 months due to the COVID-19 impact that resulted in the contract's termination as a welder in a power plant. Participant 01 went back to the Philippines on November 19, 2020 with no other choices left and with nothing but himself. Despite his unexpected retrenchment, he is thankful for the help given by the OWWA for facilitating repatriation free of charge. During his five-day stay in a hotel in Makati, he is in awe because of its extravagance and the comfort that he experienced.

*"Maganda po ang palakad na ito ng OWWA. Sa hotel po ay isa-isa kami ng room tapos minomonitor po kami maya't maya kung ikaw ba ay nilalagnat, masama ang pakiramdam, inuubo, sinisipon. Binibisita at tinatawagan po kami sa kwarto namin, basta maging tapat lang po sa nararamdaman ay wala po magiging problema (OWWA is doing a good job. We have designated hotel rooms and then they monitor us from time to time to see if you have a fever, feel bad, have a cough, or have a cold. They visit and call us in our room. As long as you are honest with your health, there will be no problem.)"*

However, behind the luxury, reality comes in.

*"Maganda po ang hotel, ang pagkain po namin ay malinis kaya lang wala naman akong income pang suporta sa pamilya ko (The hotel is nice, our food is clean but I don't have any income to support my family.)"*

Participant 01 has two children, and he shared that he does not have a stable job that can sustain his family, making him thankful for his wife's efforts to make both ends meet. He also added that his children rely on learning modules because they do not have the capacity to access an internet connection. Despite his struggle, Participant 01 still maintains a positive outlook that they can survive every passing day in their lives through God.

#### ***Burden of the Pandemic on Married Couples***

Compared to the 'normal lives' that people had before, the pandemic brought even more piles of burden, especially to the married couple. Participant 02, a former domestic helper, found her way to the Philippines after more than two years of working in Saudi Arabia due to an unexpected termination of contract. When asked about the challenges she faced during the repatriation process, she stated,

*"Sa totoo lang, wala akong tulong na natanggap sa kanila [ahensya ng gobyerno]. Tanging ang employer ko lang ang tumulong sa akin upang makauwi ako dito [Pilipinas] (Honestly, I didn't receive any help from them [government agencies]. It is just my employer who helped me get home here [Philippines].)"*

The problems that she encountered do not end after she arrives in the country. It escalates even in their source of income. At present, she is working as a cook in a small canteen near their house and is earning 250 Php a day. She admitted that she is losing hope due to the present situation and the hardship of taking care of her children and nieces and working alone as her husband also lost his job.

*"Nawawalan ako ng pag-asa dahil wala ng trabaho ang Mister ko. Mahirap din kasi ako lang ang kumakayod sa amin (I feel hopeless because my husband doesn't have a job. It's also difficult because I'm the only one providing for us.)"*

### **Negative Stigma towards Returned Migrant**

Never in the wildest imagination of a 27-year-old bachelor and marine engineer from San Jose del Monte, Bulacan that he will experience discrimination after coming home from Europe in September 2020 after he finished his two-month extension in a ship sailing to countries in Europe. In general, Participant 03 did not encounter any particular problems and had a comfortable stay during his quarantine period in Cebu City. Nonetheless, he observed significant changes in his work schedule.

*"Ngayon kasi dahil sa pandemic, hindi na certain yung araw o buwan ng alis ko eh... Supposedly ang alis ko dapat ay January or February pero namo-move kaya binigyan ulit ako ng sunod na alis ng June (Now because of the pandemic, my work schedule has become uncertain. There is no assurance that we could go back to our employer... Supposedly, I should be at work by January or February but because of the situation it was moved to June.)"*

In terms of his financial status, he has no worries because he is earning from the stock market and his siblings are equipped with stable jobs. However, his dilemma lies in his emotional well-being and how he was perceived and discriminated by his neighbors. To make a stand for himself, Participant 03 utilized social media to spread the awareness that he is not ill and not a carrier of the virus.

The existing challenges brought by the pandemic also make him realize the importance of being prepared for unexpected crises.

*"Kumuha ako ng insurance kasi naisip ko na mahirap umuwi ng may virus. Mag-aalala ang pamilya ko kaya pagkarating ko agad, sinigurado kong insured na ako para maprotektahan ang pamilya ko at ang sarili ko mula sa mga di inaasahang sakit (I avail insurance because I realize that it would be difficult to go home infected by the virus. It will worry my family so, upon my arrival, I make sure that I am already insured in order to protect my family and myself in case of an unexpected health problem.)"*

### ***Changing Lifestyle and Adapting to “New Normal”***

Dubai, UAE, is an answered prayer for the married couple, Participant 04 and 05 where they live a prosperous life for 13 years as an IT Manager and a Property Administrator/Executive Assistant in the prominent companies in Dubai. However, everything changed as the pandemic hit Dubai, resulting in Participant 04's termination of contract and the early resignation of Participant 05.

Participant 04:

*"Nag close yung company dahil sa COVID-19. Yung pinaka main branch namin sa US ay nag shutdown din kaya wala kaming chance na makahanap ulit. Nag-try kami ng 5 months na [maghanap ng trabaho], pero maraming company ang nag sara kaya ayon nag decide kami [mag-asawa] umuwi [Pilipinas] (The Company closed because of COVID-19. Our main branch in the US also shut down so we don't have a chance to find another job again. We tried looking for 5 months [work] but many companies closed down so, we [husband and wife] decided to go home [in the Philippines].)"*

Participant 05:

*"Sa akin naman, nagresign ako noong sinabi ng kumpanya namin na maari sila magsara dahil sa bankruptcy. Dahil nawalan sya [mister] ng trabaho, nag desisyon kami na umuwi sa bansa (In my case, I resigned when the company informed us of its potential bankruptcy. Since he [husband] lost his job, we decided to return to the country.)"*

After more than five months of battling and adjusting to their life in *new normal*, they confessed that they are still experiencing a great deal of stress and uncertainty. Participant 04 also sympathized with the situation of their fellow OFWs that remain abroad. *"Marami kaming kaibigan sa UAE pero ayon mahirap din sitwasyon nila doon dahil naghahanap pa rin sila ng pagkakakitaan para sa pang araw-araw nila (We still have family friends in UAE but they are also in a difficult situation of finding a source of income to sustain their needs.)"* Participant 04 and 05 affirmed that the present situation affected their outlook in life. They also stressed the importance of saving money. When asked if they will return to UAE after the pandemic ends, they affirmed that they would.

### ***Unfulfilled Dreams in Times of Pandemic***

Participant 06 is a 24-year-old OFW who came to Singapore to chase his dream to have a better future for himself and his family. He worked as hotel personnel in Singapore for 8 months and plans to extend for another 2 years. However, because of the closures of business establishments and retrenchment of workers in Singapore, his dream to stay longer in the country has been put to an end. When asked about the economic impact of the Pandemic to him, he explained how challenging it is for him to come back to the Philippines when he realized that he will not have the opportunity to extend his stay in Singapore and pay back the loan that he used to go abroad. This problem coupled up by uncertainties of livelihood upon his return contributes to the stress he experienced.

*"Ako, naka-experience ako hindi lang stress kung hindi depresyon. Napakahirap para sa akin na magsimula ulit. Nagtrabaho ako sa abroad para matupad ang mga pangarap ko pero dahil sa pandemic parang naglaho na lahat (Personally, I experienced not just stress but depression. It is very difficult for me to start again. I*

worked abroad to fulfill my dreams but because of the pandemic everything seems to disappear.)"

However, despite the difficulties, Participant 06 still continues to be a dreamer by emphasizing that in life, everything is possible. It is also important to note that in the narrative of Participant 06, Filipinos still view migration abroad as a ticket for a good life aligned with the study conducted by Asis (2006), stating that the penchant of Filipinos for working abroad could be understood in light of their desire to provide a better life for their families.

### **Online Business as a Means to Sustain Livelihood**

The advent of the pandemic brought significant changes in everyday activities and the nature of livelihood today. OFW participants shared how the pandemic affected their income. To adapt to the pressing circumstances, three out of seven participants in this study started an online business. For instance, Participant 05, together with her husband, Participant 04 started an online business in computer services. Participant 07, a 41-year-old single mother and former caregiver in Riyadh, began selling foods online.

In terms of the challenges regarding online business, Participant 07 expressed her unawareness of government programs and financial support. On the other hand, Participants 04 & 05 elaborated on the changes they encountered in starting a new normal business. Among these changes includes the shift of advertisement and service from physical to online platforms. Participant 05 claimed that it is impractical to rent a physical store. Her husband, Participant 04 supported this claim by saying, "*Hindi praktikal na mag renta ng lugar para sa negosyo. Yung mga customer, takot lumabas kaya pinalitan namin ang marketing strategy namin gamit ang social media* (It is not practical to rent a place for business. Usually consumers are afraid to go out so, we shift the marketing strategy using social media.)" Regarding their present financial status in relation to their expenses, Participant 07 stated that her income is not enough to support her daughters especially because she is a single mother and a breadwinner of the family. In contrast, Participant 04 & 05 stated that they have enough income but still emphasized on the need of alternative means for comfortable living.

The narratives presented focus on three important issues faced by migrant workers upon their return. First is the livelihood and employment issue, which was manifested by all of the returned migrants. Alongside the hardship on the process of repatriation, OFWs faced uncertain opportunities on finding a job upon their return. The recent spike on the number of unemployed Filipinos which was estimated to be at 4.5 million people in March 2020 by the PSA (de Vera, 2020) added additional complication in employment. As a means to sustain their needs, participants in the study look into online business as a source of income. However, they also emphasized that they prefer to have a stable job if the situation permits them. Second is the emotional and psychological effect of the pandemic on OFWs. Tee, M. *et al.* (2020) on their study involving 1,879 completed online surveys on Filipinos gathered from March 28-April 12, 2020 examined the psychological impact of the Pandemic in the Philippines. In total, 16.3% of respondents rated psychological impact of the outbreak as moderate-to-severe; 16.9% reported moderate-to-severe depressive symptoms; 28.8% had moderate-to-severe anxiety level and 13.4% had moderate-to-severe stress level. This emotional and psychological effect is also manifested in the participants of this study who experienced stress, anxiousness and extreme worry for themselves and for their family. Lastly is the social relations of returned migrants. The problem of negative stigma attached towards OFWs as a carrier of the virus was experienced by Participant 03 even though he tested negative

on his swab test result. To resolve this issue, he utilize social media as a way to inform his neighbors on the result of his swab and put an end on the discrimination he experienced.

### **Government Support to Returned Migrant Workers: Meaning and Purpose during the Pandemic**

Return migration has often been defined simply as going back to the country of origin. However, in reality, return is not just a unilateral course of action but a diversified and complex process that takes into account the cause of return migration, success of migration goals, as well as the preparedness of institutions in the home country to cater returned migrants (Battistella, 2018). Thus, crafting an effective and sustainable reintegration policies are vital for successful return of migrant workers. In 2019, the IOM (International Organization for Migration) introduced an integrated approach that addresses three dimensions of reintegration. The dimensions include economic which covers aspects of reintegration in ensuring livelihood, social dimension which refer to accessibility of public services and facilities such as access to health, education, housing, justice, and social security, and psychosocial dimension that deals with the assimilation of returning migrants in the community. Reintegration, in this case, can only be considered sustainable when returnees have achieved levels of economic self-sufficiency, social stability within their societies, and psychosocial well-being (IOM, 2017). When sustainable reintegration has been achieved, people are in a position to make more migration decisions as preference rather than necessity. However, attaining sustainable reintegration is not an easy task. According to Wickramasekara (2019), effective return and reintegration require that the countries of origin collaborate with destination countries to ensure the safe and dignified return of their citizens. Employers will also be expected to facilitate migrant workers' return journeys based on the contract of employment and the laws and regulations of the country of destination. Finally, the country of origin and home communities must also provide adequate reception services to returning migrant workers.

Looking in the Philippines, Republic Act no. 8042 also known as Migrant Workers and Overseas Filipinos Act of 1995 described return as a policy priority for the OFWs before departure until arrival and return (Asis, 2017). The law set out return and reintegration facilities and proposed the establishment of a Department of Labor and Employment (DOLE) Replacement and Monitoring Centre to promote the reintegration of migrant workers into Philippine society, facilitate the return to work, and tap the skills of returnees for nation-building. The law also established the Overseas Workers Welfare Administration (OWWA) role in providing social services, including the reintegration of returning workers, for the welfare and security of its overseas worker members and their families.

In 2016, OWWA was designated as a national government agency affiliated to the DOLE Overseas Workers Welfare Administration Act. Being a part of a government agency enables OWWA to perform a more active role in reintegrating returning employees as it can access government funding and migrant contributions (Wickramasekara, 2019). According to Battistella (2018), some of the Philippine reintegration services include job referrals, entrepreneurship assistance, capacity building, and counseling. Specifically, Martin (2019) offers a list of reintegration services in the Philippines which include Subsistence Development Assistance Program, Special Program for Returning Women Migrant Workers, Balik Pinas! Balik Hanapbuhay! program of livelihood support intended to provide immediate relief to returning member-OFWs (distressed/displaced), business and loan program in cooperation with the Land Bank of the Philippines and the Philippines' Development Bank, Sa 'Pinas, Ikaw Ang Ma'am/Sir which aims to win back the OFWs who have passed the Licensure Examination for Teachers, and TESDA

Online Assessment Program that provide opportunities to obtain certification or recognition from TESDA based on the level of technical skills.

During this pandemic, additional programs are launched to support returned migrants. Such programs include the Project EASE (Educational Assistance through Scholarship in Emergencies), Tabang OFW (a one-time tertiary education subsidy for dependents of repatriated, displaced or deceased OFW), DOLE-AKAP for OFWs (a 10,000 pesos financial assistance for migrant workers), and OFW RISE (Re-Integration through Skills and Entrepreneurship) Program focus on a web-based training for online entrepreneurship initiated by collaborative effort of DOLE, OWWA, TESDA, DTI, and Coca Cola Philippines. However, despite the existing plans for migrant workers, there are still problems that OFWs encounter to benefit from these initiatives. For instance, among the current programs of the government only DOLE-AKAP for OFWs are availed by Participant 01, 03, 04, 05, and 07. On the other hand, only Participant 06 and his family received an aid under SAP (Social Amelioration Program). The latter elaborated the details of the support they received from the government:

Participant 06:

*"Sa akin, una, sagot ng government yung quarantine, yung pagkain, yung service from airport to hotel. So malaking bagay siya. For my family, yung ayuda na nareceive from barangay. Yung 6,000 [Philippine peso] every 2 months. Siguro naka receive din kami around 12,000 [Philippine peso] sa family ko din. Then yung kapatid ko, doon sa Manila may nareceive din silang 8,000 [Philippine peso]. So malaking tulong sa amin (First, in my case, the government provided my quarantine expenses such as food and transportation from hotel to airport. It is indeed a big help. For my relatives, they received financial assistance from local community worth PHP 6,000 every two months. In summary, I think we received around PHP 12,000. My sibling in Manila received assistance worth PHP 8,000. It is a great help to us.)"*

As Participant 06 emphasized the significance of the financial support they received, related studies also affirmed this claim. In the thesis of Veen (2021), although accustomed with difficulties such as delays and lack of funding, few narratives of Filipino migrant domestic workers (MDWs) declared that they received other forms of help. One participant stated that she borrowed money from a relative upon returning in the Philippines to start a small business and she was able pay her debt after being granted of a financial capital aid worth of PHP 20,000 from the government. Similarly, records from Cho and Johnson (2022) shows that SAP's first and second tranche benefitted a total of 29.3 million Filipino households.

Information dissemination of the available programs initiated by the government is a big factor for a successful reintegration process. Although this study does not embody the totality of returned migrants during the pandemic, the interviews conducted by the researchers capture the dilemmas of the OFWs in getting proper information towards assistance provided by the government. When asked about the financial support that they received, Participants 03, 04, and 07 narrated the following:

Participant 03:

*"Nakatanggap po ako ng financial assistance mula sa DOLE na nagkakahalaga ng 10,000 pesos. Iyon lang ang natanggap ko kasi yun lang din ang programa na aware ako (I received financial assistance from DOLE amounting to PHP 10,000. That is what I only got because this is the only program that I am aware of.)"*

Participant 06:

*"Noong nasa Dubai ako, AKAP naman doon sa DOLE. Nag try ako, after 3 months eh tumawag – nakakuha ako ng 10,000 pesos. After noon, wala na akong alam na iba [programa]! Sakit ng ulo lang! (When I was in Dubai, there is a program there called AKAP DOLE. I tried to apply and after three months, they called and I received PHP 10,000. Afterwards, I don't know any other programs. It was such a headache!)"*

Participant 07:

*"Wala rin akong alam sa local program ng barangay. Di naman ako updated kasi. Kasi di naman talaga ako umaalis ng bahay. Wala ring SAP, kasi di ko naman alam kung anong gagawin doon kasi wala naman ngang nagsasabi. Sabi nung iba meron daw [programa] pero wala namang nagsabi sakin (I do not have any idea regarding programs in our local community. I am not updated. I also did not receive SAP, I have no idea because no one is giving information. Others said that there is [program], but no one is telling me.)"*

The statements above shows the participants' limited awareness regarding available support and other programs offered by the agencies of the government. The result coincides with the findings of Veen (2021) that many returned migrant workers availed only the assistance that they heard from their fellow OFW and they do not explore other options due to limited knowledge and source of information on whether they are qualified or not. Furthermore, it is also worthy to note the span of time that it takes to receive the financial support as can be seen in the above-mentioned experience of Participant 04. The said scenario became a common dilemma due to the inability to execute full preparedness of the government offices against the striking impact of the COVID-19 pandemic particularly in the first quarter of 2020, which is the peak season for returning migrant workers. As a result, lack of manpower and funds are mentioned to hinder the operations of these agencies (POLO Bahrain as cited in Veen, 2021). With the continued spread of the COVID-19 virus and the return of OFWs, the issues raised above remain relevant. It is now the responsibility of government and its affiliated institutions to address these significant challenges and improve services for our "modern-day" Filipino heroes.

## **Conclusion and Recommendations**

The study provides a glimpse on how COVID-19 pandemic affected the lives of Filipino migrant workers that were forced to come back to the Philippines due to the economic repercussions brought by the current health crisis. The study explains the rigorous process of repatriation that starts even before the arrival of OFWs in the country. The role of OWWA in assisting returned migrants is evident from the transportation of OFWs from the airlines, providing food and accommodation as well as securing swab test results. However, there are still issues faced by the returned migrants such as the length of stay in quarantine facilities due to delay of swab test results, lack of physical distancing in airlines and waiting



area in hotels, difficulty of accommodating additional returned migrants due to the lack of available rooms in quarantine facilities, and further problems in areas of transportation and drop off.

From the narratives gathered on the participants, the study found a relation of the pandemic towards the livelihood capability of the returned migrant, emotional well-being, which was manifested on stress level, anxiousness, and extreme worry as well as problematic social relations due to the stigma attached to migrant workers. Still, despite these challenges, having a positive outlook and hope help the returned migrants to navigate their problems and current situations.

In terms of reintegration, various government programs are also identified to address the needs of migrant workers. Nevertheless, the study found out that there are factors that affect successful implementation of government programs and policies such as the uninformed and misinformed returnees, lack of information dissemination, and limited funds of the government.

For further studies, researchers can focus on other provinces aside from Bulacan or provide more in-depth analysis on the effectiveness of economic, social and psychological programs offered by various government institutions towards OFWs and their families.

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# Effect of Fermentation Time on Rabbit Meat Jerky Processing

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## Abstract

This study aims to develop fermented rabbit meat jerky. *Lactobacillus casei* strain Shirota (Lcs) from commercially available cultured drink was used as a starter culture. Samples of jerky were fermented at 3hrs, 5hrs, and 7hrs. Parameters such as *Lactobacillus* count (CFU/g), pH, % titratable acidity, % moisture content, and water activity ( $A_w$ ) were investigated. Results revealed that fermented rabbit meat jerky has a significantly lower pH than unfermented. Percent (%) moisture content and  $A_w$  of the fermented samples are found to be comparable to other dried fermented meats. However, no significant changes were observed in % titratable acidity among the jerky produced. The results of this study provide baseline data on the microbiological and physicochemical properties of rabbit meat jerky during fermentation.

**Keywords:** *rabbit meat, Lactobacillus casei, jerky, fermentation*

## Introduction

Over the years, fermentation serves as one of the most convenient ways of preserving food. It is a process by which microorganisms such as yeasts or bacteria convert carbohydrates and proteins to alcohol and organic acids under aerobic conditions. Lactic acid fermentation is known to preserve a wide range of foods ranging from vegetables (kimchi, sauerkraut) dairy (cheese, yogurt), and meat (salami and chorizo). Lactic acid bacteria (LAB) such as *Lactobacillus* spp. *leuconostocs* and *lactococci*, can convert sugars into lactic acid. Production of lactic acid during fermentation inhibits the growth of harmful bacteria by lowering the pH while developing the flavor and aroma of the product. Recently, a growing interest occurred in obtaining jerky through fermentation.

Jerky is one of the most popular meat snacks in the world. Its popularity may be due to health benefits and convenience. It can be consumed without preparation and can be easily stored during long trips. Jerky is dried strips of meat. At present, jerky can be produced in different forms: whole-muscle or restructured. Restructured meat products are products that are chopped, ground, or flaked and then form to the desired shape. Binders are added to retain the product's structure (Lornegan and Marple, 2019). Restructuring enables small pieces of meat to be processed.

Among the popular meat that can be used are pork, chicken, and beef. In fermenting meat, an appropriate and suitable concentration of inoculum or starter culture is added to initiate the process followed by spices and or other ingredients. The primary objective of the culture is to induce the growth of concerning microorganism – *Lactobacilli*. Previous studies showed that through this process, the texture, color, and flavor of the jerky improved (Zhao *et al.*, 2018). Moreover, the use of beneficial bacteria like LAB to produce a probiotic-rich diet has long been known to prevent and treat digestive disorders, hence, considering fermented products as functional foods (Sidira *et al.*, 2019)

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Rabbit meat or commonly called *lapan* is one of the major research thrusts of Bulacan Agricultural State College (BASC). Its high protein and low cholesterol, saturated fats, sodium, and caloric count make it the most nutritious meat available to man (Foodstruct, 2020). *Lapan* also contains essential fatty acids making it superior to other types of meat such as pork, chicken, and beef. However, given this information, fewer studies regarding value adding of *lapan* are available. Thus, this study is conducted to develop *lapan* jerky through fermentation.

## Materials and Methods

### Sample Preparation

Whole frozen rabbit meat was purchased from a rabbit farm located in Bulacan. The meat was manually separated from the bone and was ground using an electric meat grinder. Other raw materials used in the study were purchased in a local supermarket in Bulacan.

### Product Formulation and Processing

Preliminary trials were conducted to determine the amount of inoculant and length of fermentation. Based on the conducted preliminary trials, the maximum length of fermentation without any noticeable spoilage organoleptic properties is 7hrs (Table 2). The amount of spices and additives used in the study were based on the previous studies conducted by Kucerova (2018) with slight modifications. Carrageenan was added as a binding agent and a commercially available probiotic drink (Yakult™) was used as the starter culture. The concentration of the starter culture used in this study was 8.91 log CFU/ml. Table 1 presents the formulation used based on the result of preliminary studies.

**Table 1**

*Product Formulation of Jerky*

Ingredients	Unfermented	Fermented
<i>Lapan</i> , g	71.60%	71.60%
Water, mL	24.00%	0.00%
Yakult™, mL	0.00%	24.00%
Spices and additives	4.40%	1.00%
Total	100.00%	100.00%

The ingredients were mixed and fermented at 35±2°C. The length of fermentations was shown in table 2. The mixtures were transferred in a piping bag. Samples were piped out at a size of 4.26mm x 2.5mm x 3mm in a tray lined with wax paper and dried at 75°C for 2 hours, then it was further dried at 90°C for 30 mins.

**Table 2**

*Treatments Used in the Study*

Treatments	Length of Fermentation
A	Control (without microbial starter culture)
B	Inoculated with Yakult™ and fermented for 3hrs
C	Inoculated with Yakult™ and fermented at 35±2°C for 5hrs
D	Inoculated with Yakult™ and fermented at 35±2°C for 7hrs

**Microbiological Analysis**

***Lactobacillus Count (CFU/g)***

Lactobacillus count (CFU/g) of the jerky samples was determined using pour plate method. A 10-g sample was homogenized and serially diluted up to 10<sup>-7</sup> using sterile phosphate buffer solution. 1-ml sample of the last two dilutions was dispensed in each Petri plate followed by the addition of 20-ml De Man, Rogosa, and Sharpe (MRS; HiMedia) agar. The plates were allowed to solidify and were incubated at 35±2°C for 72 hours.

***Physicochemical Analysis***

**pH Values.** The pH was determined in accordance with the method of Zhao (2015) with slight modification. The pH of the jerky samples was determined after the fermentation and drying process. A 5-gram sample was cut and blended with 45ml distilled water for 5 minutes and then filtered. The pH of the filtrate was then obtained using a handheld pH meter (Milwaukee pH 600).

**Titrateable Acidity (%).** The percent (%) titrateable acidity after fermentation and drying was determined. A 5-g sample was mixed with 45ml distilled water. To the mixture, a 1.0-ml phenolphthalein indicator was added. The sample mixture was titrated against a standardized 0.1 N NaOH. The endpoint was obtained when a faint pink color persist for 10 seconds. The volume of NaOH used to reach the endpoint was considered for the computation of the % titrateable acidity. The percent titrateable acidity was calculated as follows.

$$\%TA = \frac{\text{Vol of NaOH} \times \text{Normality of NaOH} \times \frac{90}{1000}}{\text{sample weigh in g}} \times 100 \%$$

**Moisture Content (%).** Moisture content of samples was determined using oven-drying method (AOAC, 1991). Samples were dried at 105°C until constant weight was achieved. Moisture content was calculated as follow:

$$\%MC = \frac{\text{Weight before drying} - \text{weight after drying}}{\text{weight before drying}} \times 100 \%$$

**Water Activity.** Water activity of the samples was measured using water activity analyzer (Biobase Model No. BWA - 3A). Samples were chopped and placed in a plastic cup container with cover inside the water activity sensor.

## Statistical Analysis and Interpretation

All analyses were done in triplicate. Data obtained were analyzed using Analysis of Variance (ANOVA) and Duncan's multiple range test was used to compare means at a 5% significance level.

## Results and Discussion

### Lactobacillus Count

Rabbit meat, like any other meat, is proteinaceous. Next to water, the major component is protein (Philippine Food Composition Table, 2022). Upon addition of LAB, this protein along with other constituents like carbohydrates and lipids are slowly metabolized and consumed by microorganisms. This allows them to multiply and grow in numbers and consequently produced organic acids (primarily in the form of lactic acid). The starter culture used in fermenting *lapan* jerky is a commercially available probiotic drink (Yakult™). The solution contains *Lactobacillus casei strain Shirota* (LcS). The initial lactobacillus count of the culture solution was 8.91 log CFU/ml. During fermentation, the amount of LAB is expected to increase up to 8 logs CFU/g and should be maintained at 6 to 7 log CFU/g throughout the lifespan of the product. As shown in Table 3, microbial count (log CFU/g) remains within the range of 8.32 to 8.43 log CFU/g.

Fermentation beyond 7hrs renders the *lapan* jerky undesirable, as it starts to produce an unwanted odor. This disadvantageous development can be attributed to the presence of spoilage-causing microorganisms in the raw rabbit meat. The microflora of rabbit meat is known to be very complex. Microorganisms like *Pseudomonas*, *Enterobacteriaceae*, coliforms, LAB, yeasts, and molds are present in significant amounts in rabbit carcass (Rodriguez-Calleja *et al.*, 2004). The presence of these microorganisms may inhibit the growth of LAB by competing with the available nutrients present in the meat.

**Table 3**

*Microbial Count (log CFU/g) of Lapan Jerky at Various Lengths of Fermentation*

Length of fermentation (hrs)	Microbial count (log CFU/g)
3	8.32
5	8.66
7	8.43

LAB proliferate best at 35±2°C. Given the appropriate temperature, even in the presence of minimal nutrients, these microorganisms can proliferate. Since *lapan* is abundant in protein (Table 4), LAB tends to use this instead as their source of energy, which then results in proteolysis and lipolysis (for the lipids present). Unlike carbohydrates, metabolic products of *Lactobacillus casei* from proteins and lipids are related to the production of flavors and aroma (Adams, 2010), hence, prolonged fermentation may result in off-flavor and odors as observed in the preliminary study of this research.

Bekasam, a fermented product from Indonesia, which is usually made from fish is now made using rabbit meat. Wulandari *et al.*, (2020) evaluated the probiotic lactic acid bacteria diversity of rabbit meat bekasam-fermented meat. Results showed that the highest group of microorganisms present is LAB (8.67 log CFU/g) followed by yeast (8.58 log CFU/g). This shows that the microbiological character of fermented *Japan* jerky, is somewhat similar to the same type of products, such as bekasam.

**Table 4**

*Proximate Composition of Rabbit Meat*

Proximates (g)	Amount per 100 g
Water	78.4
Protein	18.2
Total Fat	2.4
Carbohydrate, total	0.0
Ash	0.1

Reference: Philippine Food Composition Table, DOST-FNRI

In preserving foods through fermentation, the rate of fermentation is one of the crucial parameters. Jerky can be processed either with slabs of meat or ground meat. Due to the carcass composition of rabbit (Hernández and Blasco, 1996), the researchers opted to use ground meat. In fact, the increased surface area allows for a faster rate of fermentation, as more water becomes available for biochemical reactions of microorganisms. Moreover, as the fermentation rate increases in favorable temperature (35±2°C), it should not be overlooked that some spoilage and pathogenic microorganisms such as *Enterobacteriaceae*, may grow as well with LAB, thus may increase the risk of foodborne illness (Jay, 2000). For this reason, it is precisely critical to choose the appropriate fermentation hours.

**pH Change after Fermentation and after Drying**

**Table 5**

*Mean Values for pH of Fermented Jerky after Fermentation and after Drying*

Treatments	pH	
	After Fermentation	After Drying
A	6.31±0.16 <sup>a</sup>	6.39±0.16 <sup>a</sup>
B	5.85±0.05 <sup>b</sup>	6.21±0.13 <sup>b</sup>
C	5.73±0.08 <sup>b</sup>	6.07±0.12 <sup>b</sup>
D	5.73±0.05 <sup>b</sup>	6.05±0.03 <sup>b</sup>

Legend: Mean ± standard deviation.

Means with different superscripts within the same column are significantly different at *p* (<0.05).

A: Control (without microbial starter culture).

B: Inoculated with Yakult and fermented at 35±2°C for 3hrs.

C: Inoculated with Yakult and fermented at 35±2°C for 5hrs.

D: Inoculated with Yakult and fermented at 35±2°C for 7hrs.

A pH measures the acidity or basicity of a solution. Treatment A has a significantly higher pH than the other treatments. Treatment A has no starter culture and possibly did not undergo fermentation. Thus,



it is expected that it would have a higher pH. On the other hand, no significant differences were observed among jerky with Yakult™ fermented at 3hrs, 5hrs, and 7hrs. During fermentation, the *Lactobacillus casei* present in Yakult produces lactic acid and other organic acids that in turn reduce the pH of the jerky. However for this LAB to cause a significant amount of acids and to significantly lower the pH, sufficient time may be needed. As shown in this study, fermentation of 7hrs was insufficient to cause a significant reduction in pH. The same was observed in the study of Fadlillah *et al.* (2020), wherein fermentation of rabbit meat using *L. plantarum* for 12 to 18 hours did not result in a significant reduction in its pH.

According to Zhao *et al.* (2015), a lower pH in meat promotes the reduction of sodium nitrite and decreased the amount of residual nitrite, thereby reducing carcinogens- nitrosamines produced by nitrite and secondary amines. After drying, an increase in pH was observed, but still, the unfermented jerky (treatment A) is significantly higher than the fermented jerky (Treatment B, C, and D). The slight increase in pH after drying may be attributed to the loss of moisture and other volatile organic acids, which then results in a more meat-rich product. Determining pH is one of the key determinants of LAB activity. As LAB grows in number, the production of lactic acid as well as other acids increases, thus, reducing the pH of product. This decrease contributes directly to microbial safety as some spoilage and pathogenic microorganisms have no ability to tolerate lower pH (Adams and Moss, 2008). The distinct sour-like characteristics of fermented products are also attributed to this parameter.

### Titratable Acidity (TA) after Fermentation and after Drying

The percent (%) titratable acidity of the samples after fermentation ranged from 0.249 to 0.262% expressed as lactic acid (Table 6). A slight increase in the % TA was observed after drying. This is due to the removal of moisture during drying thereby resulting in a more concentrated product. Naturally, meat contains lactic acid. After the animal has been slaughtered, the glycogen in the meat is converted into lactic acid (FAO, 2020). During fermentation, additional lactic acid is produced. Yakult™ contains *Lactobacillus casei*, a gram-positive lactic acid bacterium (Lorenzo, 2018). The lactic acid bacteria (LAB) produce lactic acid as their major fermentation product. However, despite this, no significant increase was observed in all fermented products.

**Table 6**  
*Mean Values for %TA of Fermented Jerky after Fermentation and after Drying*

Treatments	% Titratable Acidity	
	After Fermentation	After Drying
A	0.249±0.012	0.320±0.012
B	0.253±0.009	0.343±0.014
C	0.257±0.022	0.293±0.053
D	0.262±0.045	0.369±0.034

Legend: Mean ± standard deviation.

Means with different superscripts within the same column are significantly different at p (<0.05).

A: Control (without microbial starter culture).

B: Inoculated with Yakult and fermented at 35±2°C for 3hrs.

C: Inoculated with Yakult and fermented at 35±2°C for 5hrs.

D: Inoculated with Yakult and fermented at 35±2°C for 7hrs.

During fermentation, microorganisms, in general, utilize the available nutrients present, such as carbohydrates, proteins, and fat as their source of energy. One of the byproducts of their metabolism is the production of organic acids, which cause fermented products to have lower pH and a distinct sour taste. In the case of LAB, the major metabolic end-product is lactic acid, and this is produced when carbohydrate sources were metabolized (Adams, 2010). Since rabbit meat has no carbohydrates (Table 4) and the supplemented carbohydrate source is minimal, it is not enough to support the production of lactic acid.

### Water Activity and Moisture Content

Water activity ( $A_w$ ) is a measure of the availability of water for biological functions and relates to water present in a food in a free form (Ray, 2005). Microorganisms utilized this water to grow and multiply. Thus, determining the  $A_w$  is crucial to food stability and food safety. The  $A_w$  of the jerky after drying ranges from 0.84 to 0.87 (Table 7). Minimizing the  $A_w$  is critical in inhibiting the growth of pathogens. An  $A_w$  of 0.85 or less is recommended in ready-to-eat products like jerky in order to control the growth of harmful microorganisms (FSIS, 2012). The values reflected in this paper are somewhat comparable but still, additional interventions should be done to achieve a much lower  $A_w$ , and in turn, produce a safer product.

**Table 7**

*Mean Values of  $A_w$  and % Moisture Content of Fermented Jerky after Drying*

Treatments	$A_w$	% Moisture content
A	0.874 <sub>±0.009</sub>	38.51 <sub>±5.51</sub>
B	0.854 <sub>±0.024</sub>	30.66 <sub>±2.31</sub>
C	0.860 <sub>±0.009</sub>	33.40 <sub>±1.20</sub>
D	0.844 <sub>±0.021</sub>	28.31 <sub>±0.36</sub>

Legend: Means with different superscripts within the same column are significantly different at p (<0.05).

A: Control (without microbial starter culture).

B: inoculated with Yakult and fermented at 35<sub>±2</sub>°C for 3hrs.

C: Inoculated with Yakult and fermented at 35<sub>±2</sub>°C for 5hrs.

D: Inoculated with Yakult and fermented at 35<sub>±2</sub>°C for 7hrs.

In this study, the moisture content of the *lapan* jerky ranged from 28.31% to 38.51%. Drying has been traditionally used to preserve meats. The moisture content (MC) affects the stability, safety, and sensory properties of foods. The values obtained in this study are comparable to other fermented meats like dried salami and pepperoni where moisture content ranges from 20-45% and  $A_w$  of 0.85-0.86 (Ockerman and Basu, 2014). Considering the  $A_w$  and moisture content of all treatments, the jerky produced can be classified as intermediate moisture foods (IMF). These are foods that have a moisture content of 10-50% and  $A_w$  0.65-0.90 (Batt & Tortorello, 2014). Bacteria cannot grow on IMF due to its low  $A_w$ , however, yeasts and molds may grow (Ray, 2005).

### Conclusions and Recommendations

The study shows the effect of fermentation on the microbiological and physicochemical properties of rabbit meat jerky. The resulting product after fermentation has a high moisture content, pH and  $A_w$ , and low % TA which may shorten its shelf life. Hence, intervention in the process and formulation is suggested. To increase the production of lactic acid as indicated by %TA and pH, it may be necessary

to provide additional sources of carbohydrates in the formulation as substrates for *L. casei* and prolong the fermentation hours. Rabbit meat contains complex microflora thus, pretreatment of the raw rabbit meat prior to fermentation to eliminate undesirable microorganisms must be taken into consideration. In addition, other byproducts during fermentation should also be monitored such as free amino acids.

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# Effect of Microwave and Oven Drying to the Drying Characteristics, and Quality of Stingless Bee (*Tetragonula biroï*) Pollens

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## Abstract

Stingless bee pollens are good source of vitamins and minerals that can be collected from the surplus of bees. The effect of two drying methods on the drying characteristics, and nutritive value of the stingless bee pollens has been investigated. Microwave drying and oven drying were the methods applied in the study. Results revealed that microwave drying, outweighs oven drying almost in all drying parameters. In terms of the quality of stingless bee pollens, there was no significant difference found in the pH level of the microwave and oven dried samples except for the water activity. For the nutritive value of stingless bee pollens, oven drying showed higher beta carotene content compared to microwave drying but was found to be not statistically different to each other. On the other hand, microwave drying showed higher protein and vitamin E content but was also found to be not statistically different from each other.

**Keywords:** *drying, microwave, oven, pollen, stingless bee*

## Introduction

Bee pollen is a rich source of essential nutrients and is regarded as one of nature's complete foods. It's rich in calcium, vitamins, minerals, and antioxidants, all of which are important to our health. It contains a lot of B vitamins, which are essential for brain health. Protein, one of the most valuable components of bee pollen, is essential for the development of healthy skin, bones, and muscles (Campos *et al.*, 2008; Miranda *et al.*, 2020). Worker honeybees collect bee pollen when foraging. Honey supplies carbohydrates for honeybees, but bee pollen provide all of the nutrients that honey can't provide. Humans take advantage of the opportunity to collect excess bee pollen using pollen traps when pollen production peaks.

Honey has always been the main product from honeybees. Like honey, bee pollens can also be produced for human consumption and pharmaceuticals. Bee pollen is a perishable commodity and exposure of fresh bee pollens to moisture will promote deterioration. Because the bee pollen will be processed and stored as food or supplement, the need for an efficient drying technique is required to maintain the nutritive value of the product (Campos *et al.*, 2010; Miranda *et al.*, 2020).

After collection the bee pollens are normally stored in the freezer to prolong its shelf life. But considering that bee pollens will be packed dry in bottles, sachet or in capsules, drying is a better option. Drying of honeybee pollen is essential in improving storage life and meeting market requirement. The need for drying prevents mold formation and eventual deterioration.

Air drying is not enough to meet market requirement and it can expose the product to

contaminants therefore using dryers is essential. Also, the cold storage system throughout its distribution chain is not always available and dried pollen is currently the requirement for sales. Stingless bee pollens take around three weeks of air drying before the product is ready for sales. The amount of time to dry the product can cause delay in the marketability and longer exposure during air drying can cause food contamination. Drying time also influence power consumption as longer drying consumes more energy. This will result to higher production cost affecting the income of the bee producers or processors.

As fresh bee pollen contains a considerable amount of moisture, it can be a natural breeding ground for bacteria and fungi. Drying, which is a technique for preserving bee pollen, has been used for many years, but the study showed that dehydrating pollen causes the depletion of some of the vital nutrients in bee pollens (Campos *et al.*, 2008). Microwave drying, another form of dehydration, has been tested and stated to have less drying time compared to traditional drying without or less impact on the nutritional value of the product. In effect, this decreases energy demand while increasing output (Pereira de Melo & Almeida-Muradian, 2010; Miranda *et al.*, 2020). Therefore, the purpose of the study is to evaluate the properties and drying characteristics of stingless bee pollens dried using oven drying and microwave drying to determine the difference between the two drying methods. Specifically, to compare the drying time, moisture reduction rate, and recovery of microwave and oven drying and to evaluate the quality of the dried pollens in terms of pH, water activity, protein, vitamin E, and beta carotene.

## Materials and Methods

### Preparation of Materials

Fresh stingless bee pollens were bought at a bee farm in Sorsogon City. The samples were kept refrigerated until they were ready to be processed. The frozen bee pollens were allowed to warm up to room temperature before being dried. The pollens were cleaned manually by extracting foreign materials such as dead bees and bee legs. To achieve homogeneity in the samples, the bee pollens were mixed.

Six 150 grams of stingless bee pollens were used to compare the microwave and oven drying. Both drying techniques were tested for their drying performance. The temperature of the oven dryer was set at 45 °C while the microwave dryer was set at 700W. Moisture content of the samples in both drying conditions were recorded with 30 minutes intervals (or as needed) until 7% moisture content was reached. Final weight of the sample with 7% moisture content was computed using (1) (PAES, 2010; Somerville, 2012; Miranda *et al.*, 2020).

$$W_f = \frac{W_i (100-MC_i)}{(100-MC_f)} \quad (1)$$

Where  $W_f$  is the final weight of the sample (g),  $W_i$  is the initial weight of the sample (g),  $MC_i$  is the initial moisture content (%), and  $MC_f$  is the final moisture content (%).

### Comparison of Microwave Drying and Oven Drying

The microwave dryer by Miranda *et al.*, (2020) and an oven dryer (MEMMERT) was used for the microwave drying, and oven drying of the stingless bee pollens, respectively. Microwave drying and oven drying methods were evaluated using the following parameters:

### **Moisture Reduction Rate**

The moisture reduction rate of the microwave dryer was computed using (2) (Abano, 2016).

$$M_{Cr} = \frac{M_{Ci} - M_{Cf}}{T_d} \quad (2)$$

Where  $M_{Cr}$  is the moisture reduction rate (%/h),  $M_{Ci}$  is the initial moisture content of test material (%),  $M_{Cf}$  is the final moisture content of test material (%), and  $T_d$  is the actual drying time (h).

### **Percentage Recovery Output**

Percentage recovery is defined as the ratio of final weight of dried output to initial or fresh weight of sample material expressed in percent using (3) (PAES, 2000).

$$PR = \frac{W_f}{W_i} \times 100 \quad (3)$$

Where  $PR$  is the percentage recovery (%),  $W_i$  is the initial weight of test material (g), and  $W_f$  is the final weight of test material (g)

### **pH and Water Activity**

The pH level of stingless bee pollen was measured using a bench top professional pH meter (TRANS INSTRUMENTS) while water activity was tested using a water activity meter (NOVASINA).

### **Protein, Vitamin E and Beta Carotene Content**

Analysis for beta carotene, protein and vitamin E content of the stingless bee pollens was done by Sentrotek in Mandaluyong City. Protein content was determined using Kjeldahl method while vitamin E and beta carotene content was measured using high performance liquid chromatography.

### **Statistical Analysis**

The stingless bee pollens dried using microwave drying and oven drying were compared and analyzed using independent t-test with 5% level of significance.

## **Results and Discussion**

### **Drying Characteristic**

#### **Drying Time**

Drying time is an important parameter in drying. Lessening the drying time of commodities will provide an ample time for other activities and hasten its processing. The drying time of stingless bee pollens as influenced by microwave and oven drying method were shown in Table 1. The result of the analysis found that there was a significant difference between the drying time of stingless bee pollens using microwave and oven drying treatments.

**Table 1**

*Drying Characteristics of Stingless Bee Pollens Using Microwave and Oven Drying*

	<b>MICROWAVE DRYING</b>	<b>OVEN DRYING</b>
Drying time, hr	0.07±0.00a	182.00±21.00b
Moisture Reduction Rate, %/hr	89.98±11.15a	0.03±0.00b
Percentage Recovery Output, %	93.62±0.74a	94.62±0.00a
pH	3.88±0.02a	3.87±0.03a
Water Activity	0.29±0.01a	0.33±0.01b

Note: Means with the same letters within columns are not significantly different at 5% level of significance

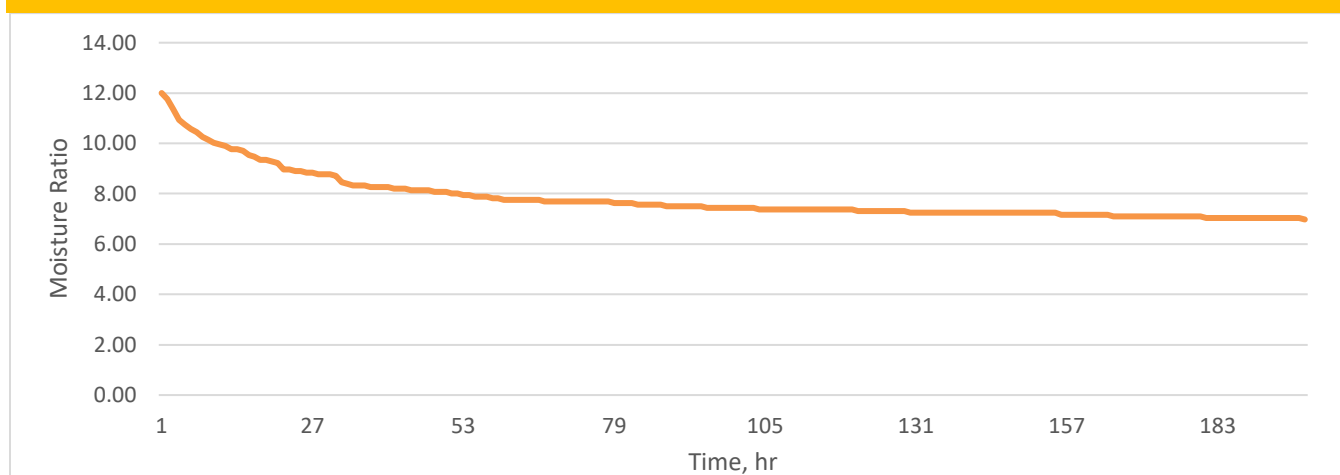
Using the microwave drying method, drying time was faster and only requires less than an hour of operation of 0.07 hours. The drying time of the oven drying method had significantly longer drying time of 182 hours to reach the desired level of moisture of around 7%.

**Moisture Reduction Rate**

The drying characteristic of the stingless bee pollen using oven and microwave drying were represented as drying curves plotted in moisture ratio against drying time as shown in Fig. 1 and 2, respectively.

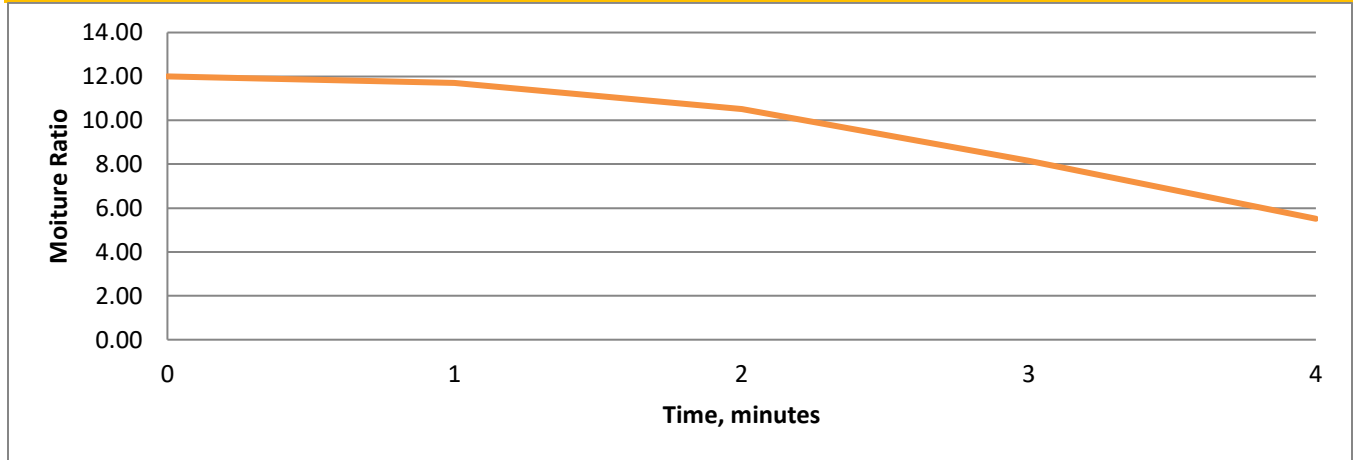
**Figure 1**

*Drying Curve Using Oven Drying Method*





**Figure 2**  
*Drying Curve Using Microwave Drying Method*



When using oven drying, there was an increase in moisture loss during the first 3 hours of drying and constant weight loss thereafter. In microwave application, moisture losses at initial stage were slow and start to build up upon completion of drying.

The microwave drying treatment have significantly higher reduction rate of 89.98%/hr compared to oven drying. A 0.03%/hr drying rate was observed from the oven drying treatment.

The moisture reduction rate of stingless bee pollens as influenced by microwave and oven drying method were shown in Table 1. The result of the analysis found that there was a significant difference between the moisture reduction rate of stingless bee pollens using microwave and oven drying treatments.

The reason for the decrease of moisture of the stingless bee pollens was due to the higher water molecules content of the samples during the start of the drying that results to a higher absorption of microwave energy. This high absorption of energy leads to higher moisture loss due to moisture diffusion. Continuous moisture loss after the initial stage of drying causes less absorption of microwave energy of the product. This results to the decrease in the drying rate. This phenomenon was due to the generation of heat inside the sample creating a large vapor pressure difference with its surface as a result of volumetric heating (Zarein *et al.*, 2013).

**Percentage Recovery Output**

Table 1 shows the mean percentage recoveries as affected by the different drying methods. The result of the analysis found that there was no significant difference between the percent recovery of stingless bee pollens using microwave and oven drying treatments.

## Quality Parameters of Dried Stingless Bee Pollens

### ***pH***

pH level is the degree of acidity or alkalinity of a substance. Acidic food has a pH value between 0 and 7 while alkaline foods has pH value between 7 and 14 having 7 as neutral in the case of distilled water.

The pH levels of dried stingless bee pollens as influenced by microwave and oven drying method were shown in Table 1. The result of the analysis found that there was no significant difference between the pH values of stingless bee pollens using microwave and oven drying

The pH value of the microwave and oven dried stingless bee pollens in aqueous solution were found to be acidic. These values were slightly lower compared to the pH range of 4 to 6 based on the Technical Regulation for bee pollen (Rebelo *et al.*, 2016). However, these values are acceptable for storage as they are lower than a pH value of 5 where most microbes stop growing (METER Group, n.d.).

### ***Water Activity***

Water activity is an important factor for the preservation of dried commodities. Depending on the level of water activity, microbial growth are prevented which can lead to the spoilage of the product. Therefore maintaining or lowering the water activity should be reduced to minimum.

The effect of using microwave and oven drying to the water activity of dried stingless bee pollens was shown in Table 1. A significant difference was found in the water activities of stingless bee pollens using microwave and oven drying treatments.

The result of the analysis shows that water activity was affected with different drying process. Specifically, microwave drying of stingless bee pollens produce lower water activity values compared to oven drying.

Data suggest a stable product with no microbial proliferation as all values falls below a water activity of 0.6 which is the growth limit for common microorganisms (METER Group, n.d.). Therefore, development of various microorganisms that deteriorate food can be prevented or stopped resulting to food with better shelf life (Rebelo *et al.*, 2016).

## Stingless Bee Pollen Composition

The chemical composition of bee pollens depends on various factors such as floral source, location, climate, soil, species and activity of bees. This can lead to better quality bee pollens compared to others (Campos *et al.*, 2008; Barajas *et al.*, 2012; Di Pasquale *et al.*, 2013; Komosinska-Vassev *et al.*, 2015).

**Figure 3**

*Stingless Bee Pollens*



**Protein**

The effect of using microwave and oven drying to the protein content of dried stingless bee pollens was shown in Table 2.

**Table 2**

*Protein Content of Dried Stingless Bee Pollens Using Microwave and Oven Drying*

	<b>MICROWAVE DRYING</b>	<b>OVEN DRYING</b>
PROTEIN, %w/w	18.00±0.36a	17.73±0.12a
VITAMIN E, mg/100g	0.32±0.12a	0.19±0.04a
BETA CAROTENE, mg/100g	0.12±0.07a	0.40±0.23a
PROTEIN, %w/w	18.00±0.36a	17.73±0.12a

Note: Means with the same letters within columns are not significantly different at 5% level of significance

Results show that there was no significant difference in the protein content of stingless bee pollens dried using microwave. The protein content of the microwave dried sample is greater than the value that was stated by Miranda *et al.* (2020). They reported 16.1%w/w protein content in the microwave dried sample from the fresh sample of 16.7%w/w. This can be the result of the change in the target moisture content from 4% to 7%, from Miranda *et al.* (2020) and this paper, respectively.

**Vitamin E**

The vitamin E content of dried stingless bee pollens as influenced by microwave and oven drying method were shown in Table 2. The result of the analysis reveals that there was no significant difference between the vitamin E content of stingless bee pollens using microwave and oven drying treatments. Similar with the findings for the protein content, the target moisture content may be a factor affecting the nutritive value of the microwave dried samples. Miranda *et al.* (2020), reported 2.8 mg/100g vitamin E content from a 1.1 mg/100g fresh sample, their findings is greater than the value stated in this study.

## **Beta Carotene**

Beta carotene is a provitamin that is a substance needed or can be converted into vitamins. Carotenes are sensitive to light and oxygen but stable even at high temperatures. Drying of products with carotene can concentrate its antioxidants content and preserve carotenoids (Barajas *et al.*, 2012).

The effect of using microwave and oven drying to the beta carotene content of dried stingless bee pollens was shown in Table 2. Results show that there was no significant difference in the beta carotene content of stingless bee pollens dried using microwave and oven dryer. The result shows that the microwave dried sample has lower beta carotene content compared to the reported value of Miranda *et al.* (2020), of 0.226 mg/100g.

## **Conclusion and Recommendations**

Based on the results of the study, the drying time, and moisture reduction rate of using microwave drying to stingless bee pollens greatly outweighs the oven drying method, while parameters like percentage recovery, and pH prove to have no significant difference from each other. In terms of the nutritive value, the protein, vitamin E and beta carotene content of microwave and oven dried stingless bee pollens were found to be not significantly different to each other. Therefore using microwave drying can provide the same quality of oven dried stingless bee pollens but in a faster and more efficient way possible. Comparing results on the nutritive value of the microwave dried sample from previous work shows that the final moisture content may be a factor influencing the nutritional content of dried stingless bee pollens. Hence, it is recommended to use microwave drying as rapid method of drying stingless bee pollens with similar quality with oven dried bee pollens. Also, more in depth study about the effect of various parameter combinations is necessary to further improve the quality of the dried stingless bee pollens.

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## Growth Performance of Mallard Duck Fed Azolla as Partial Replacement of Soybean Meal

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### Abstract

To evaluate the growth performance of mallard ducks fed azolla as partial replacement of soybean meal, a study was carried out from April 6, 2020 to June 6, 2020 in San Ildefonso, Bulacan. A total of apparently healthy, 180 heads of 15-day-old mallard ducks (90 female and 90 male) were used in the study with 2 x 3 factorial experiment in Completely Randomized Design (CRD). Factor A was the sex of ducks while Factor B was the level of substitution. Mallard ducks with a 10% substitution level were significantly better than the 20% substitution level in terms of weight gain, feed consumption, feed conversion ratio (FCR), and ROI. Further analysis on the dressing percentage revealed that there was no significant effect on the sex of ducks, level of substitution and interactions between the two factors. The results of the study revealed that the azolla meal diets have nutritive and feeding values based on the proximate analysis being conducted. It was concluded that Azolla at 10% level in the diet improved gain in body weight, feed consumption and FCR especially on both sexes of ducks. Using mash rations with the inclusion of Azolla at 10% level could be used as substitutes for soya bean meal on mallard duck diet. All these facts suggested further study on other level of substitutions of Azolla to soybean meal to gain additional knowledge about its effects, study focusing on only one sex of mallard duck to further analyze the economics and tried to other animals, such as swine and ruminants, as an alternative source of protein with 10% level of substitution, and educate and encourage farmers through training and seminars to raise and produce azolla in order to make it readily available to animals, especially during lean months, as arable areas for feed crops are declining due to the higher populations of both humans and animals.

**Keywords:** *azolla, mallard duck, soybean meal, mash ration*

## Introduction

In the Philippines, duck production is a lucrative enterprise. It is a multi-billion-dollar industry with a diverse group of stakeholders, including duck farmers, egg vendors, feed mills, hatcheries, processors, and rice farmers, who gain both direct and indirect benefits from the business. As of 31 March 2022, the country's total production of ducks stood at 12.54 million birds (PSA, 2021).

About 31.0 percent of duck population was recorded in Central Luzon, followed by SOCCSKSARGEN with 12.3 percent share and Cagayan Valley with 10.2 percent share (PSA, 2022).

Duck production is one aspect of an integrated farming system that is considered part of sustainable agricultural development and one of the innovations that can be applied by farmer to increase the efficiency and sustainability of land use in rice field (Vipriyanti *et al.*, 2021). The main stock used is the Pateros duck, which exhibits varied physical and production performance due to lack of organized selection and mating systems. It also shows high genetic diversity based on simple-sequence repeats markers (Magpantay *et al.*, 2019). These are large, with heavy bodies, rounded heads, and wide flat bills. As with many dabbling ducks, the body is long and the tail rides high out of the water, set back to the rear.

Some of the ingredients used in mixed feeds, especially cereal grains, are in high demand for human consumption, apart from the high and fluctuating prices. There were also huge increases in the prices of some suppliers of vegetable protein. These increases in the cost of traditional raw materials have speeded up demand for alternative feed options that can replace a proportion of these items in poultry diets at lower production costs. (USDA, 2015).

Conventional animal feeds are severely in short supply. Using unconventional feed sources more effectively is essential to feeding the animals in the future. Partially bridging the feed supply gap could be non-traditional feeds. They lessen animal and human food competition, cut the price of feed, and help the body produce enough nutrients on its own (Sontakke, 2014).

An important feed element is the Azolla (*Azolla pinnata*). It is a productive plant and a genus of seven species of aquatic ferns in the Salviniaceae family. It is high in proteins and mineral, fixes nitrogen and is palatable to chickens, pigs, poultry, goats, and cows, and can be grown on any closed body of water (Agrifarming, 2020).

Feeding ducks properly is a challenging act of balancing animal needs, production methods, productivity, local tradition and feeding costs (Mavromichalis, 2013). Hence, mash form of feeds with the inclusion of Azolla in the earlier stage of ducks was studied.

This study aimed to determine the growth performance of ducks fed with mash ration with the inclusion of Azolla as partial replacement for soya bean meal. Specifically, it aimed to: determine the growth performance of Mallard duck; identify the optimum level of Azolla leaf meal as a protein substitute; evaluate the dressing percentage of Mallard duck given mash feeds with Azolla leaf meal inclusion; and find out the economic viability of using Azolla leaf meal on Mallard duck production through cost and return analysis.

## Materials and Methods

### Locale of the Study

The experiment was carried out at Barangay Sta. Catalina Matanda, San Ildefonso, Bulacan. The area was characterized as low-level, with slightly sloppy areas, an area of 40.5 m<sup>2</sup> and a sufficient source of water due to the presence of a pond making it suitable for the production of animals.

The site was typically classified as having a distinct wet and dry season under Type I of the Philippine Climate Corona classification (DA-Region XI Research Division, 2015).

### Experimental Design and Treatments

A 2 x 3 factorial experiment in Complete Randomized Design (CRD) was used in the study. Factor A was the sex of ducks while Factor B was the level of substitutions of Azolla leaf meal in the diet. Six treatment combinations with three replications each were used in the study. A total of apparently healthy, 180 heads of 15-day-old Mallard duck (90 female and 90 male) were used as experimental animals, with a space allocation of 3 ducks/sq.m. There were 10 ducks per replication, or 30 ducks per treatment.

The level of Azolla substitution used was 10% and 20% because a prior study found that a 7.5% level of substitution increased feed intake and body weight gain in broiler chickens (Kumar *et al.*, 2018). The author is interested in figuring out what would happen if it were raised to a 10% level. She wanted to assess whether raising it to 20% would have any impact. Additionally, the author was interested in determining whether raising the level of inclusion would be economically feasible.

### Analysis and Test of Experimental Treatments

Azolla leaf meal was examined and checked at the Department of Agriculture- Feed Chemical Analysis Laboratory-DA-RFO 3 for proximate analysis.

**Table 1**

*Complete Proximate Analysis of Azolla Leaf Meal*

Parameter	Result
% Moisture Content	8.0 ± 0.1
% Crude protein	27.0 ± 0.8
% Ash Content	22.6 ± 3.6
% Crude Fat	3.6 ± 0.6
% Phosphorus	10.5 ± 0.1
Metabolizable Energy	2241.5 kcal/kg



## Experimental Ration

Azolla was collected from ponds, washed, drained and dried in sun. The maximum moisture content of the experimental treatment should not exceed 12%. It was ground until it became a leaf meal. Mixing of the ration was done a day before offering to the Mallard ducks. The replacement of soybean meal with Azolla leaf meal was depended on the percentage amount on the treatment.

## Nutrient Requirement of Mallard Duck

**Table 2**

*Composition of Experimental Ration (Mash) and Calculated Nutrient Analysis*

<b>Ingredient</b>	<b>B1</b>	<b>B2</b>	<b>B3</b>
Corn, Yellow	58.85	57.15	54.30
Azolla leaf meal	-	3.53	7.06
Soya US	20.00	16.97	12.94
RBD1	5.50	7.00	4.85
FM-Peruvian	6.15	7.50	9.00
Copra Meal	5.35	3.55	5.70
Limestone	1.00	1.00	1.00
Dicalcium phosphate	0.15	0.15	0.15
Molasses	3.00	3.15	5.00
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated Analysis</b>			
ME, kcal/kg	2895	2885	2834
C. Protein, %	20.05	20.09	20.09
C. fat, %	4.41	4.57	4.59
C. fiber, %	2.92	3.08	3.33
M+C, %	0.71	0.69	0.66
Lys, %	1.12	1.09	1.03
Ca, %	0.82	0.84	0.87
Threonine, %	0.77	0.74	0.70
Tryptophan, %	0.23	0.21	0.20
P, Av.%	0.34	0.38	0.42

## Feed Processing

The manufacture of feeds from available feed ingredients essentially involves a formulation process, acceptance of available feed ingredients, reduction in the size of the raw materials, weighing/proportioning, and mixing of the various ingredients into homogeneous blends (PCAARDDOST, 2015)

### **Steps in Manual Feed Mixing**

1. Feedstuffs were purchased from a dependable source.
2. The raw materials purchased were already ground.
3. Different feed materials were weighed and proportioned of the according to the experimental formulation.

4. Mixed the minor ingredients (lysine, methionine, limestone, salt, premixes) were mixed obtain uniform distribution of the ingredients.
5. The major ingredients (Corn, Soya Us, Azolla leaf meal, RBD1, FM) were mixed using a mixer for five minutes. Minor ingredients were mixed with the major ingredients for another five minutes.
6. The molasses was thoroughly mixed during the process

## **Management Practices**

### ***Housing***

The housing used in this study was open-sided for proper ventilation. For the roof, the house was consisted of coconut timber, net, and galvanized iron. The house measured 3x13.5m<sup>2</sup> and divided into eighteen cages per replication. There were ten ducks per enclosure.

### ***Weighing and Grouping of Birds***

The experimental birds' weight was taken and recorded as the initial weight before the study began, and distributed to their respective pens. Random picking was carried out by grouping the birds to their respective treatment. The birds' final weight was taken and recorded at the end of the study.

### ***Feeds and Feeding***

During the course of the analysis, mash form of feed was fed to the ducklings. Formulated starter feeds (corn +soybean meal, 10% azolla inclusion, and 20 % azolla inclusion) were given three times a day to the ducklings from the beginning until the end of the study and were given from age 22 to 82.

### ***Provision of Drinking Water***

Throughout the study sufficient water were given at all times. This allowed the ducks to get deep, allowing their heads to immerse and not themselves to prevent the scaly and rusty eyes that may cause blindness.

### ***Sanitation Practices***

During the experiment, the elimination of manure was performed to avoid foul odors and to prevent disease-causing diseases. Thorough cleaning of feeders and waterers was done on a daily basis.

## **Statistical Analysis of Data**

The data obtained were evaluated following the Analysis of Variance (ANOVA), and treatment differences were compared by applying the Least Significant Difference (LSD) test.

## Results and Discussions

### Mean Gain in Weight

In this study, individual effects on gain in weight values of ducks raised fed with formulated diet with corn and soybean meal were not significantly different to 10% level of azolla substitution but were significantly higher at 5% level of significance than the ducks raised fed with 20% level of Azolla substitution. This difference could be related to the fact that Azolla leaf meal had a high fiber content and ducks were less capable of digesting cellulosic materials.

Poorer weight gain of ducks (male and female) fed a diet containing 20% of azolla leaf meal could be attributed to the lower feed intake and therefore a reduced metabolizable energy intake. This observation was noted especially during the first two weeks of feeding when most of the ingredients left in the feeding troughs were basically azolla meal. This means that ducks refused to consume higher inclusion rates of azolla meal in the diet possibly due to its higher fiber content.

Previous reports made by Basak *et al.* (2002) and Beckangham *et al.* (1978) have implicated high levels of ADF (30.08) and lignin (28.42) as the main factor limiting the efficient utilization of azolla meal by monogastric animals. Further analysis of the interaction between the combined sex of ducks and the level of substitution showed that there was no significant difference in weight gain. As a result, azolla meal can be used as a substitute since control treatment was already a standard diet.

**Table 3**

*Mean Gain in Weight (kg) of the Mallard Ducks as Affected by Varying Levels of Azolla Substitution.*

Level of Substitution	Sex of Ducks	
	A1 Male	A2 Female
B1-formulated mash ration (soybean + corn)	0.71a	0.78a
B2-formulated mash ration with 10% Azolla substitution	0.75a	0.74a
B3- formulated mash ration with 20% Azolla substitution	0.65b	0.60b

Note: \*Different letters (x-y) following the means between rows (sex of ducks) are significant at 5% (LSD) level. Different letters (a-c) following means between columns (level of substitution of Azolla) are significant at 5% (LSD) level.

\*Means of the same letter are not significantly different.

### Mean Feed Consumption

Table 4 below shows that the sex of ducks has significant effect on the feed consumption at 5% level of significance with  $F=7.05$  as the female consumed more feeds (control and 10% azolla inclusion) than the male ducks. Steczny K. *et al.* (2017) stated that compared with females, males consumed less feed to 21 days old. However, they showed a poorer feed conversion ratio (FCR) per kg of the weight gain over that period.

Further review disclosed that there was noteworthy effect on the level of substitutions as to the feed consumption at 5% level of significance with  $F= 4.38$ . The result shows that experimental ducks fed with the control diet consumed more feeds than with the higher level of inclusion (20%); however, it must be noted that feeding with 10% inclusion was comparable and exhibited good results. The lower feed consumption of ducks fed azolla meal at 20% indicated that palatability may have been adversely affected by its inclusion. This observation is justified by the relatively high amount of azolla meal observed in the leftovers of the experimental birds.

This is consistent with the study conducted by Bestat and Morenton (1985) and cited by Basak (2002) that azolla affected the palatability of the feed resulting in reduced feed consumption. Moreover, the analysis on the relationship between the sex of ducks and the level of substitution indicated that there was no indicative effect on feed consumption.

**Table 4**  
*Mean Feed Consumption (kg) of the Mallard Ducks as Affected by Varying Levels of Azolla Substitution.*

Level of Substitution	Sex of Ducks		
	A1 Male	A2 Female	A1 Male
B1-formulated mash ration (soybean + corn)	4.73	4.89	4.81a
B2-formulated mash ration with 10% Azolla substitution	4.53	4.80	4.67ab
B3- formulated mash ration with 20% Azolla substitution	4.09	4.65	4.37b
Mean	4.45y	4.78x	

Note: \*Different letters (x-y) following the means between rows (sex of ducks) are significant at 5% (LSD) level. Different letters (a-c) following means between columns (level of substitution of Azolla) are significant at 5% (LSD) level.

\*Means of the same letter are not significantly different.

**Mean Feed Conversion Ratio**

The table 5 revealed that the experimental male ducks fed with 20% level of substitutions has a notably effect on the feed conversion ratio at 5% level of significance at  $F=4.09$ . The least feed conversion ratio was attained by experimental ducks fed with 10% level of substitution. Further study revealed that amongst the different treatment combinations, ducks from A2B3 (Female Mallard ducks fed with 20% Azolla substitution) showed the highest feed conversion ratio at 7.75, while the ducks that had the lowest feed conversion ratio were the ducks from A1B2 at 6.05. This means that it takes 7.75kg and 6.05kg of feeds to increase the weight of mallard ducks by 1 kilogram for both treatments, respectively. Increase feed intake or decrease gain in weight contributed to the FCR.

For the interactions of the combined effects of the sex of ducks and the Azolla substitution, it was found out that there was a significant effect at 5% level of significance with  $F = 5.71$  on 20% substitution level. This finding explains that the ability of ducks to convert feed into meat depends on the composition and structure of the feeds. This is consistent with the idea put forward by Buckingham et

al. (1978) that the growth rate is attributed to the high level of ADF (acid detergent fiber) and lignin content of azolla meal, which is a factor limiting the efficient use of azolla in monogastric animals.

This also confirmed the findings of Castillo *et al.* (1981) that monogastric animals such as broilers are inefficient in digesting cellulosic materials such as high fiber content found in azolla meal. While Basak *et al.* opined that higher levels of fiber in aquatic plants could be the reason for decreased use of nutrients and ultimately reduced FCR.

Based on the results of the study, it was evident that the inclusion of a 10% substitution level can be used as a substitute since it obtains the least FCR in comparison to the control diet, which means that mallard ducks can convert meat with a lower feed intake efficiently.

**Table 5**  
*Mean Feed Conversion Ratio of the Mallard Ducks as Affected by Varying Levels of Azolla Substitution.*

Level of Substitution	Sex of Ducks		Mean
	A1 Male	A2 Female	
B1-formulated mash ration (soybean + corn)	6.68	6.26b	6.47
B2-formulated mash ration with 10% Azolla substitution	6.04	6.45b	6.24
B3- formulated mash ration with 20% Azolla substitution	6.29	7.75a	7.02*

Note: Different letters (x-y) following the means between rows (sex of ducks) are significant at 5% (LSD) level. Different letters (a-c) following means between columns (level of substitution of Azolla) are significant at 5% (LSD) level.

(\*) Following the means between rows (combinations) are significantly different

**Mean Dressing Percentage of Male and Female Mallard Duck Given Mash Feeds with Azolla Leaf Meal Inclusion**

Dressing percentage was one of the most important parameters for the determination of the marketable portion of poultry. The higher the dressing percentage, the higher the profit. A further test was carried out and stated that there was no compelling effect on the dressing percentage with respect to the sex of ducks, the level of substitution and interaction on the combined effects of Azolla. It was noted that the 10% inclusion of azolla meal in the diet had a promising outcome and was consistent with control.

This is consistent with the Basak *et al.* (2002) investigation into the use of Azolla pinnata meal as an additional 5 per cent feed for commercial broiler chicks in Bangladesh, which found that dressing and giblet percentages increased significantly with 5 per cent azolla meal. The dressing percentage ranged numerically between the different groups and the higher dressing percentage was recorded in T3 followed by T2, T4 and the lowest in T1. p. Basak *et al.* (2002) reported similar findings that the use of Azolla meal in the broiler ration improved performance and was used as a safe diet. However, variation in observation may be due to differences in bird species, levels of Azolla powder inclusion, agro-climatic conditions, and other factors. Higher dressing percentage in T3 and carcass yield in T4

may be due to the positive influence of Azolla powder, which has increased the body weight of the broilers. Similar findings were also reported by Basak *et al.* (2002); Naghshi *et al.* (2014) who also reported higher dressing and carcass yields when Azolla was added to the broiler diet.

**Table 6**

*Dressing Percentage of the Mallard Ducks as Affected by Varying Levels of Azolla Substitution.*

Level of Substitution	Sex of Ducks	
	A1 Male	A2 Female
B1-formulated mash ration (soybean + corn)	80.87	73.34
B2-formulated mash ration with 10% Azolla substitution	74.70	76.36
B3- formulated mash ration with 20% Azolla substitution	79.14	71.26

Note: \*Different letters (x-y) following the means between rows (sex of ducks) are significant at 5% (LSD) level. Different letters (a-c) following means between columns (level of substitution of Azolla) are significant at 5% (LSD) level.

\*Means of the same letter are not significantly different.

**Optimum Level of Azolla Leaf Meal as a Protein Substitute**

With regard to the optimum level of substitution of Azolla, it was observed in the Table 3, mean gain in weight (kg) of the mallard ducks as affected by different treatments that there was a decrease in the mean weight gain of mallard ducks, as the substitution of Azolla increased by 20% compared to 10% for both male and female ducks. Similarly, when it comes to feed consumption, it was noted that 10% substitution consumed more feed than any other diet, although it was almost on the control diet.

In addition, it was noted in the experiment that the minimum amount of feed required to produce one kilo of meat was shown to be the lowest value of the average FCR of 6.05. This means that ducks on a 10% substitution diet have converted feeds into weight gain more efficiently compared to ducks on a 20% substitution basis. In addition, male and female mallard ducks with 10% substitution performed well on their dressing percentage. In the end, based on the results of the study, the most optimal substitution of Azolla was 10%, and the application and decision will depend on which factor the farmer wanted to consider.

**Cost and Return Analysis**

As shown in Table 7, the cost and return analysis of mallard ducks fed with different treatments showed that 10% of azolla meal in male and female mallard ducks was ranked second highest in terms of net income at 810.59 and 1.133.23; ROI at 25.73 and 29.69; and total live weight at 33.00 kg which have a positive effect on earning more profits. Azolla meal with 10% inclusion may be used as a replacement for soybean meal although the highest net income and return on investment was achieved by female ducks in the control treatment and this was attributed to the fact that the formulated starter with corn and soybean meal was already the standard feed given to the ducks and sold the produced liveweight at a high price.

In addition, the highest ROI and net income of female mallard duck subject to 10% inclusion was achieved due to the fact that it was sold at a higher price, which is why it can compensate for the high cost per unit. Female and male mallard ducks earned 33.00kg of break points, which means that a farmer needs to produce a higher live weight than that to make better income. Moreover, male mallard duck that was subjected also to 10% inclusion exhibited lowest cost per unit that is why it obtained better profits.

**Table 7**

*Cost and Return Analysis of Mallard Ducks as Affected by Varying Levels of Azolla Substitution.*

	<b>B1-Corn + Soybean meal</b>		<b>B2-10% Azolla Inclusion</b>		<b>B2-10% Azolla Inclusion</b>	
	<b>A1-Male</b>	<b>A2- Female</b>	<b>A1-Male</b>	<b>A2- Female</b>	<b>A1-Male</b>	<b>A2- Female</b>
<b>SALES</b>						
Total weight produced (kg)	32.10	34.50	33.00	33.00	31.10	30.00
Sales of Mallard duck (PHP120/kg-male; PHP150/kg- female)	3,852.00	5,175.00	3,960.00	4,950.00	3,372.00	4,500.00
<b>GROSS SALES (PHP)</b>	<b>P3,852.00</b>	<b>P5,175.00</b>	<b>3,960.00</b>	<b>4,950.00</b>	<b>3,372.00</b>	<b>4,500.00</b>
<b>EXPENSES</b>						
Stocks (PHP) 180 heads of mallard duck at PHP20 (male) and PHP35 (female)	600.00	1,050.00	600.00	1,050.00	600.00	1,050.00
Feeds Starter feeds (PHP)	2,611.15	2,700.79	2,386.35	2,603.71	2,238.70	2,539.80
Labor cost at P0.04/hd/day x 60days (PHP)	72.00	72.00	72.00	72.00	72.00	72.00
Housing (depreciation cost-PHP)	P91.06	P91.06	91.06	91.06	91.06	91.06
<b>TOTAL EXPENSES (PHP)</b>	<b>3,374.21</b>	<b>3,913.06</b>	<b>3,149.41</b>	<b>3,816.77</b>	<b>3,001.76</b>	<b>3,752.86</b>
<b>NET INCOME (PHP)</b>	<b>477.79</b>	<b>1,261.94</b>	<b>810.59</b>	<b>1,133.23</b>	<b>730.24</b>	<b>747.14</b>
<b>ROI (%)</b>	<b>14.16</b>	<b>32.24</b>	<b>25.73</b>	<b>29.69</b>	<b>13.99</b>	<b>19.90</b>
<b>BREAK EVEN POINT</b>	<b>32.10</b>	<b>34.50</b>	<b>33.00</b>	<b>33.00</b>	<b>31.10</b>	<b>30.00</b>
<b>COST PER UNIT</b>	<b>105.11</b>	<b>113.42</b>	<b>95.43</b>	<b>150.00</b>	<b>96.51</b>	<b>150.00</b>

## Conclusions

1. The results of the study revealed that the azolla meal diets have nutritive and feeding values based on the proximate analysis conducted. Azolla at 10% level in the diet improved gain in body weight, feed consumption and FCR for both sexes of ducks.
2. On the other hand, the most optimal substitution of Azolla was 10%, as there were no significance differences among the different treatment combinations particularly the control treatment.
3. Based on the outcome of the study, it was stated that there was no compelling effect on the dressing percentage with respect to the sex of ducks, the level of substitution and interaction on the combined effects of azolla. It was noted that the 10% inclusion of azolla meal in the diet had a promising result and was consistent with control.

4. On the cost and return analysis, inclusion of 10 % azolla meal on the diet of male mallard ducks ranked the first in ROI and total liveweight produced that have a positive impact to gain a higher ROI and net income. Generally, it may be further concluded that Azolla is a good source of protein and may be used up to 10% level in ducks' diet for better performance.

## **Recommendations**

Based on the results obtained, the following are recommended.

1. Further study on other level of replacement of azolla to soybean meal are encouraged to gain additional knowledge about its effects on the growth performance of mallard ducks focusing on only one sex and other animals such as swine and ruminants, as an alternative source of protein.
2. Additional study on feeding fresh azolla for mallard ducks as substitute for soybean meal may also be tried to discover the optimum level of replacement.
3. Further study on lowering the inclusion of azolla leaf meal to determine the effects on dressing and carcass yield percentage with respect to the sex of ducks.
4. Based on the result of the study, azolla may be advised to use as an alternative feed substitute to reduce the cost of producing ducks and other farm animals. It is an unconventional feed ingredient at low price and may be used as a poultry feed to reduce the cost of production and could be a sustainable replacement option to save the cost of feeds in particular.

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“Trust in the LORD with all your heart; and lean not to your own understanding. In all your ways acknowledge him, and he shall direct your paths”. Proverbs 3:5

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## Growth Performance of Mallard Ducks Fed Soybean Curd Residue (SCR) as Partial Replacement for Soybean Meal

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### Abstract

To evaluate the production performance of male and female mallard ducks fed soybean curd residue as a partial replacement for soybean meal, a study was conducted from April 6, 2020, to June 6, 2020, at Buhol na Mangga, San Ildefonso, Bulacan. One hundred eighty mallard ducks (90 male and 90 female) were used in the study with a two-factor factorial experiment in Completely Randomized Design (CRD). Factor A was the level of substitution (basal feeds formulated duck starter/grower feeds, soybean curd residue as 15% replacement for soybean meal in formulated duck starter/grower feeds and soybean curd residue as 20% replacement for soybean meal in formulated duck starter/grower feeds) while factor B was the sex of the mallard ducks. The performance of mallard ducks in terms of final weight, weight gain, average feed consumption, feed conversion ratio, dressing percentage, and visceral organs weight both at 15% and 20% inclusion rates of soybean curd residue (SCR) for starter and grower rations are similar to the animals fed of soybean meal. There is a considerable rise, however, in the carcass weight in terms of the sex of the mallard ducks raised. The use of soybean curd residue (SCR) as substitute to soybean meal (SBM) is more profitable for farmers since it reduces the production cost of raising mallard ducks. Conclusively, soybean curd residue is reasonable to use as a substitute for soybean meal.

**Keywords:** *basal feeds, formulated feeds, inclusion, ration, substitution*

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## Introduction

In the Philippines, the duck industry is the second most popular poultry species next to chicken. Farmers or backyard raisers raise more than 75 percent of the ducks in our country with less than 100 heads per household. Ducks are generally bred for their meat and their eggs. It can live in a wide range of climatic conditions and feeds and is immune to specific avian diseases (Chang *et al.*, 2004).

The total duck inventory as of January 2017 stood at 10.84 million birds. It registered an increment of 3.09 percent from the previous year's stocks of 10.52 million birds. Based on the 2019 PSA data, about 68.87 percent of ducks in the country are raised through backyard farming, while the rest, or 31.13 percent, are grown in commercial farms.

The high cost of feeds constitutes one of the main constraints in poultry production. At present, researchers are trying several feedstuffs and supplements to reduce the cost. Proper selection of feed supplements that is readily available in the locality is one of the good factors suggested by experts to give attention to.

Soybean is one of the most frequently or widely used ingredients in feed. Soybean and its components are valuable raw materials for the Philippine food and feed industries and are one of the most popular food crops worldwide today. Based on how it is used, this legume can be categorized as a legume, oil-herb, or even source of fuel. Following extrusion cooking, whole beans are primarily used as full-fat protein meal for livestock. They are also refined into specific food items such as soy milk and tofu, or soybean curd (taho and tokwa). Soya meal, a by-product of oil extraction, is mainly used by the livestock industry as the key source of protein for feed (Enicola, 2008).

Data from the BPI show that the area planted to soybean in the Philippines is a mere 1,000 hectares. For our domestic needs, which exceed as much as 300,000 metric tons annually, the country is currently highly dependent on imports. The primary sources are United States, Brazil, and Argentina. The amount of soybean is estimated to be less than 100,000 tons per year for direct use, whether for feed or food. Food soybeans are mainly sourced from Canada and China (bpi.da.gov.ph. Retrieved March 19, 2019).

Production of soybean products has been growing worldwide, and there has been a related rise in the amount of soybean curd residue (SCR) being discarded. The disposal of the soybean curd residue has become a concern due to its environmental pollution. It is high in fiber (25%), fat (10%), protein (25%), vitamins and trace elements. It has potential for value-added production and consumption that at the same time, carries the promise of increased economic gain and reduced environmental emission potential (Li *et al.*, 2013).

This research was, therefore, conducted to find out the growth responses of male and female ducks fed with different levels of soybean curd residue as a partial replacement for soybean meal. The general objective of this study was to determine the effect of soybean curd residue on the production performance of male and female mallard ducks. Specifically, it aimed to determine the production performance including the gain in weight, feed consumption, final weight, feed conversion ratio, dressing percentage, carcass, organ weight, and cost and return analysis.

## **Materials and Methods**

### **Locale of the Study**

The experiment was conducted at Barangay Buhol na Mangga, San Ildefonso, Bulacan. It has a sandy clay loam soil type that is suitable for agricultural production.

The area is described as having pronounced wet and dry seasons that fall under the Type I category of the Modified Corona Philippine Climate Classification (Provincial Planning and Development Office, 2013).

### **Experimental Birds**

A total of 180 fourteen-day-old male and female mallard ducklings (90 male and 90 female) were used in the study.

### **Collection of Test Material**

The soybean curd residue (SCR) was collected at Sumandig, San Ildefonso, Bulacan. The samples were sun-dried for three days and subjected to proximate analysis at the Department of Agriculture Feed Chemical Analysis Laboratory, DA RFO III, City of San Fernando, Pampanga.

### **Experimental Design and Treatments**

A two-factor factorial experiment in Completely Randomized Design (CRD) was used in the study. Factor A was the level of substitution of soybean curd residue in the diet, while Factor B was the sex of ducks. Six treatment combinations with three replications each were used in the study.

### **Management Practices**

#### ***Housing***

The housing used in the study was made of coco lumber and net. The house measured 41.4 square meters. There were ten ducks per pen per replication.

#### ***Preparation of the Ration***

Soybean curd residue samples were gathered from Sumandig, San Ildefonso, Bulacan. The samples were dried and pulverized. The replacement of soybean meal with the experimental treatment was based on what has been specified in the treatment. Proper weighing and proportioning of feed ingredients were done, and these were immediately mixed using a feed mixer to avoid poor distribution of ingredients. The maximum moisture content of the experimental treatment ration did not exceed 12%.

#### ***Feeding Trial***

Two types of feeds were fed to the ducks throughout the study. Feeds were offered ad libitum from the start until the end of the study.

The schedule of feeding was as follows: day 21-55 will use formulated duck starter mash type of feeds while day 56-81 will use formulated duck grower mash instead.

Formulated duck starter mash ration was fed according to treatments during the start of the study up to 55 days old, and formulated duck grower mash ration were fed from 56 days old up to the end of the study. The birds were fed ad libitum and were given fresh water at all times during the study.

**Table 1**

*Nutrient Specifications for Ducks*

<b>Nutrient</b>	<b>Starter</b>	<b>Grower</b>
Energy, ME Kcal/kg	2800-2900	2800-3000
Crude Protein %	19-22	15-16
Crude Fat%	4.0 – 4.5	4.0 – 4.5
Crude Fiber	NMT 8	NMT 8
Calcium %	0.90-0.95	1.0-1.1
Phosphorus, available %	0.40-0.44	0.40-0.44

Reference: Feed Reference Standards 4<sup>th</sup> Edition PHILSAN

**Table 2**

*Ingredients Composition of Starter Ration*

<b>Ingredient %</b>	<b>T1 (Control)</b>	<b>T2 (15% SCR)</b>	<b>T3 (20% SCR)</b>
Corn, yellow	54.50	49.20	44.65
Rice bran (D1)	3.50	-	-
Molasses	4.00	5.00	9.0
SBM, USHP	23.08	18.00	18.70
SCR	-	12.60	16.74
Fishmeal Peruvian	6.32	6.50	5.41
Wheat Pollard, Hard	-	7.00	3.50
Copra meal	7.0	-	-
Limestone (C)	1.10	1.18	1.00
Monocalcium phosphate	0.50	0.40	0.75
DL-methionine	-	0.12	0.15
L-lysine	-	-	0.10
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated Analysis</b>			
ME, kcal/kg	2835	2829	2831
Crude Protein, %	21.41	21.40	21.37
Crude Fat, %	4.19	4.05	4.02
Crude Fiber, %	2.96	4.09	4.23
Ca, %	0.93	0.92	0.90
P, Av.%	0.43	0.42	0.44

**Table 3***Ingredients Composition of Grower Ration*

<b>Ingredient %</b>	<b>T1 (Control)</b>	<b>T2 ( 15% SCR)</b>	<b>T3 (20%SCR)</b>
Corn, yellow	64.65	60.88	58.00
Rice bran (D1)	5.00	-	1.95
Molasses	5.10	6.00	8.00
SBM, USHP	12.50	10.00	9.40
SCR	-	9.12	12.15
Fishmeal Peruvian	4.00	2.30	3.05
Copra meal	4.00	6.00	-
Limestone (C)	1.45	1.40	1.50
Monocalcium phosphate	0.80	1.20	1.10
Wheat pollard hard	2.00	2.20	4.10
DL Methionine	0.15	0.30	0.30
L-Lysine HCL	0.35	0.60	0.45
Total	100.00	100.00	100.00
<b>Calculated Analysis</b>			
ME, kcal/kg	2890	2887	2888
C. Protein, %	15.99	15.96	15.96
Crude Fat	4.23	4.21	4.12
Crude Fiber	2.82	3.73	3.78
Ca, %	1.03	1.02	1.06
P, Av.%	0.41	0.42	0.43

**Sanitation Practices**

Cleaning of the feeding and watering troughs was done regularly. Removal of manure was done every day during the study to avoid foul odor and to maintain proper sanitation.

**Statistical Analysis of Data**

The data collected were analyzed using Analysis of variance (ANOVA) in Two Factor Factorial in Completely Randomized Design (CRD), and differences in treatment means were compared using Least Significant Design at a 5% level of significance.

## Measurement of Production Performance

Initial weight, final weight, gain weight, feed consumption, feed conversion ratio, dressing percentage, carcass and organ weight, and cost and return analysis are data to be gathered to measure the production performance. For initial weight birds were weighed 21 days after brooding and for final weight it was taken when the birds were already 81 days old at the termination of the study.

Gain weight was taken by getting the difference of the final weight and the initial weight of the birds. For feed consumption this was taken by subtracting the feed refusal from the total feed offered. Feed refusal was taken every morning before offering new feeds to experimental ducks. The FCR was taken by dividing the feed consumed by the total gain weight of the ducks.

The weight of carcass and visceral organs such as heart, liver and gizzard was taken and recorded. Dressing percentage was taken by dividing the carcass weight by the live weight multiply by 100.

For the cost and return analysis, all expenses that were incurred were recorded in determining the cost of production. Gross income, net income and return on investment were also computed.

## Results and Discussion

### Initial Weight

As shown in Table 4, the highest initial weight was recorded in T2 (soybean curd residue as 15% replacement for soybean meal in formulated duck starter/grower feeds in Male Mallard duck) at 362.83 g. Initial weight was taken and used to determine the effect of the different experimental treatments in the gain in weight of the animals, which was the first parameter of the study. The two-way ANOVA did not show any significant difference in the combined effects of the levels of substitution and the sex of the mallard ducks. The individual effects also did not show any significant difference at the 5% level of significance. Results indicate that the ducks make up for good test subjects because there are no variations in their initial weight.

**Table 4**

*Initial Weight (g) of the Mallard Ducks*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	349.5	344.5	347.00
T2 (15% SCR)	362.83	325.67	344.25
T3 (20% SCR)	338.5	351.67	345.08
Mean	350.28	340.61	



## Gain in Weight

The Analysis of Variance revealed that there were no interactions at the 5% level between levels of substitution and sex of ducks in terms of gain in weight. As shown in Table 5 the heaviest weight gain was observed in T3 with the 20% replacement of SCR in formulated feeds in male mallard ducks at 625.17g. It is also observed that the mean of T3 (20% replacement of SCR) regardless of sex was highest compared to other treatments.

**Table 5**

*Gain in Weight (g) of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	551.50	555.83	553.66
T2 (15% SCR)	560.50	594.33	577.41
T3 (20% SCR)	625.17	596.33	610.75
Mean	579.06	582.16	

## Feed Consumed

For the combined effects of the level of the soybean substitution and the sex of the mallard ducks, two-way ANOVA did not show any significant effect on the feed consumed of the mallard ducks. There was no interaction either shown in the individual effects of the soybean substitution and the sex of the mallard ducks on the feed consumed by the mallard ducks. From this, it can be assumed that all the treatments were the same when the feed consumption was used as the point of comparison. As shown in Table 6, the highest consumption was found in T3 (20% replacement of SCR in Female Mallard duck) at 4592.17 g, and the lowest consumption was found in T1 (Basal feeds in Male Mallard duck) at 4501.67g.

**Table 6**

*Feed Consumption (g) of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	4501.67	4546.83	4524.25
T2 (15% SCR)	4581.17	4571.33	4576.25
T3 (20% SCR)	4548.83	4592.17	4570.50
Mean	4543.89	4570.11	

### Final Weight

As shown in Table 7, the highest final weight was observed in T3 (SCR as 20% replacement for soybean meal in formulated duck starter/grower feeds in Male Mallard duck) at 963.67 g. The lowest final weight was found at T1 (Basal feeds (soybean meal + corn) in formulated duck starter/grower feeds in Female Mallard duck) at 900.33. Like the previous parameter, two-way ANOVA did not show any significant effect on the combined effects of the sex of the mallard duck and the soybean substitution levels. The individual effects of the treatments did not show either any interactions with the final weight of the mallard ducks. On the other hand, it was observed that the mean final weight of male mallard duck was higher than female mallard duck. It was also observed that as the level of substitution increases, the higher the final weight of mallard ducks was recorded regardless of sex. It is an excellent indication that SCR can be used as a substitute for soybean meal.

**Table 7**

*Final Weight (g) of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	901.00	900.30	900.66
T2 (15% SCR)	923.30	920.00	921.66
T3 (20% SCR)	963.70	948.00	955.83
Mean	929.33	922.78	

### Feed Conversion Ratio

The ability to convert feed into the meat of any animal is a very important aspect that greatly affects the profitability of animal production. The lower the numerical value, the better is the feed conversion ratio. The two-way ANOVA, however, did not show any significant difference in the combined effects of the level of the soybean substitution and the sex of the mallard ducks. Like the previous parameter, the individual effects of the soybean substitution and the sex of the mallard ducks did not show any significant effect on the average feed consumed by the mallard ducks either. As shown in Table 8, the lowest feed conversion ratio was found in treatment T3 (soybean curd residue as 20% replacement for soybean meal in formulated duck starter/grower feeds in Male Mallard duck) at 7.29. On the other hand, even though there are no significant differences shown in the different treatments between the main factor and sub-factor, it was observed that the mean of the FCR of the male ducks was lower than the female ducks. Also, as the level of substitution was higher, the FCR mean was lower which is safe to assume that soybean curd residue is reasonable to use as a substitute for soybean meal.

**Table 8***Feed Conversion Ratio of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	8.16	8.23	8.19
T2 (15% SCR)	8.19	7.72	7.95
T3 (20% SCR)	7.29	7.81	7.55
Mean	7.88	7.92	

### Dressing Percentage

The treatments did not show any significant difference in the combined effects of the level of the soybean substitution and the sex of the mallard ducks. The same case also was observed in both individual effects of the two said factors. On the other hand, as to the sex of ducks, the highest mean of dressing percentage was observed in males at 68.60%. Moreover, as to the level of substitution, it is noticeable that as the level of substitution increases, the mean of dressing percentage also increases. Much like the previous parameters, it could be presumed that SCR is a good protein source that can substitute for soybean meal.

**Table 9***Dressing Percentage of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	64.09	62.47	63.28
T2 (15% SCR)	67.42	62.84	65.13
T3 (20% SCR)	74.28	64.15	69.21
Mean	68.60	63.15	

### Carcass Weight

The highest carcass weight was observed in T3 (soybean curd residue as 20% replacement for soybean meal in formulated duck starter/grower feeds in Male Mallard duck) at 650g. The lowest average carcass weight was found in T1 (Basal feeds (soybean meal + corn) in formulated duck starter/grower feeds in Female Mallard duck) at 560g. Like the previous parameter, the treatments did not show any significant difference in the combined effects of the level of the SCR substitution and the sex of the mallard ducks. However, the sex of the mallard ducks had a significant effect on the carcass weight at a 5% level of significance with  $F = 5.28$ . This shows that male mallard ducks' carcasses tend to be heavier than female mallard ducks; the result is somewhat similar to the study of Boos *et al.* (2002), wherein males were, on average of 15% heavier and 18% larger than females.

**Table 10**

*Carcass Weight of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

Treatments	Sex of Ducks		Mean
	(Male)	(Female)	
T1 (Control)	563.33	560.00	561.66
T2 (15% SCR)	588.33	563.33	575.83
T3 (20% SCR)	650.00	573.33	611.66
Mean	600.55a	565.55b	

Note: Sex of ducks means having different letters (a-b) are significant at 5% level

### Organ Weight

The weight of the liver, gizzard, and heart was relatively close to each other. By using two-way ANOVA, it was observed that the treatments did not show any significant difference in the combined effects of the level of the soybean substitution and the sex of the mallard ducks. The individual effects of the two factors also did not show any significant difference. This shows that there is no negative effect on the visceral organs of the ducks with regard to the substitution of soybean curd residue irrespective of the sex of the ducks.

**Table 11**

*Organ Weight of the Mallard Ducks Fed Varying Levels of Soybean Curd Residue.*

	T1 (Control)		T2 (15% SCR)		T3 (20% SCR)	
	(Male)	(Female)	(Male)	(Female)	(Male)	(Female)
Liver Weight	20.00	20.00	20.67	20.00	23.33	20.00
Gizzard Weight	46.67	43.33	46.67	46.67	46.67	40.00
Heart Weight	9.33	9.33	10.00	10.00	9.33	10.00

### Cost and Return Analysis

The 20% level of substitution of SCR as a replacement for soybean meal in male mallard ducks resulted in lower cost of production because of lower feed cost for those ducks fed SCR in the diet. However, the highest return on investment (ROI) was recorded in the 20% level of substitution of SCR in female mallard ducks at 21.32% due to the higher selling price/kg live weight of female mallard ducks compared to male mallard ducks, which gives a positive impact to gain a highest net income. On the other hand, as shown in the break-even point calculation in 20% level of substitution of SCR in female mallard ducks, in order to produce profit, the amount of sales required to cover all the variables and fixed costs are greater than 28.44kgs and the cost of producing a kilogram of mallard ducks is ₱123.64.

**Table 12**

*Cost and Return Analysis of mallard ducks fed varying levels of soybean curd residue.*

	T1-corn + soybean meal		T2- 15% Soybean Curd Residue		T3- 20% Soybean Curd Residue	
	B1- Male	B2-Female	B1- Male	B2-Female	B1- Male	B2- Female
<b>SALES</b>						
Total weight produced (kg)	27.03	27.01	27.7	27.6	28.91	28.44
Sales of Mallard duck	₱3,243.60	₱4,051.50	₱3,324.00	₱4,140.00	₱3,469.20	₱4,266.00
<b>GROSS SALES</b>	<b>₱3,243.60</b>	<b>₱4,051.50</b>	<b>₱3,324.00</b>	<b>₱4,140.00</b>	<b>₱3,469.20</b>	<b>₱4,266.00</b>
<b>EXPENSES/COST</b>						
Stocks 180 heads of mallard duck at P20 (male) and P35 (female)	₱ 600.00	₱ 1,050.00	₱ 600.00	₱ 1,050.00	₱ 600.00	₱ 1,050.00
Feed						
Starter feeds	₱1,362.56	₱1,379.29	₱1,313.75	₱1,308.51	₱1,307.87	₱1,330.93
Grower feeds	₱1,114.81	₱1,123.13	₱1,035.38	₱1,035.38	₱1,006.62	₱1,006.62
Labor cost at P0.04/head/dayx60days	₱72.00	₱72.00	₱72.00	₱72.00	₱72.00	₱72.00
Housing Depreciation cost of housing	₱56.80	₱56.80	₱56.80	₱56.80	₱56.80	₱56.80
<b>TOTAL EXPENSES</b>	<b>₱3,206.17</b>	<b>₱3,681.22</b>	<b>₱3,077.93</b>	<b>₱3,522.69</b>	<b>₱3,043.29</b>	<b>₱3,516.35</b>
<b>NET INCOME (₱)</b>	<b>₱37.43</b>	<b>₱370.28</b>	<b>₱246.07</b>	<b>₱617.31</b>	<b>₱425.91</b>	<b>₱749.65</b>
<b>ROI (%)</b>	<b>1.17</b>	<b>10.06</b>	<b>7.99</b>	<b>17.52</b>	<b>13.99</b>	<b>21.32</b>
<b>BREAK EVEN POINT</b>	<b>27.03 kgs</b>	<b>27.01 kgs</b>	<b>27.70 kgs</b>	<b>27.60 kgs</b>	<b>28.91 kgs</b>	<b>28.44 kgs</b>
<b>COST PER UNIT</b>	<b>118.62</b>	<b>136.29</b>	<b>111.12</b>	<b>127.63</b>	<b>105.27</b>	<b>123.64</b>

Note: Selling price/kg live weight of male ₱ 120.00 and female mallard ducks ₱150.00  
Starter feed cost/kg: T1-(Control) = P 18.91, T2-(15% SCR) = P 17.76, T3-(20% SCR) = ₱17.74  
Grower feed cost/kg: T1-(Control) = P 17.01, T2-(15% SCR) = P 16.32, T3-(20% SCR) = P 16.04

**Conclusion**

The performance of mallard ducks in terms of final weight, weight gain, average feed consumption, feed conversion ratio, dressing percentage, and visceral organs weight both at 15% and 20% inclusion rates of soybean curd residue (SCR) for starter and grower rations are similar to the animals fed of soybean meal. There is a considerable rise, however, in the carcass weight in terms of the sex of the mallard ducks raised. The use of soybean curd residue (SCR) as substitute to soybean meal (SBM) is more profitable for farmers since it reduces the production cost of raising mallard ducks.

## Recommendation

Soybean curd residue as a replacement for soybean meal is strongly recommended to be used by small to medium-scale duck farms and by feed millers at a 20% level of substitution.

Study on higher substitution levels of soybean curd residue at a 30% level of substitution is also encouraged to gain further information about its effects.

Soybean curd residue is also recommended to be tried in other animals, such as swine and ruminants, as an alternative protein source.

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The **Southeast Asian Journal of Agriculture and Allied Sciences (SAJAAS)** is the new research journal of Bulacan Agricultural State College. This journal will be an international double-blind peer-reviewed journal, with plans for open access and international indexing.

1. The article should be typed on an A4 size bond paper, with 1 inch margins on top, right, and bottom, and 1.5 inch on the left. The text should be in Arial font size 11 with 1.5 line spacing. The article should not exceed 16 pages and 6000 word limit, including the abstract, figures, tables, and references.
2. The **cover page** contains the title of the article and the name, affiliation, address and email of the author/s. The **name of the author/s or their affiliations** shall not be indicated anywhere in the body of the paper.
3. The second page contains the **abstract**. It should be a paragraph that concisely informs the reader about the topic, methods and main findings. It must contain up to 250 words only and must not contain undefined abbreviations. Below the abstract are the list of up to five keywords about the paper, to be used for indexing purposes. The abstract page should only contain the title, abstract and keywords.
4. The body of the article should contain the following sections:
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- The **Results and Discussion** section should present a solution to the problem stated in the introduction. Subsections should make reading easier. If tables and figures are used to visually show the results, only the critical data should be restated in the text to emphasize evidence on which the conclusions are based. The data should also be interpreted in this section. Conclusions and recommendations are also stated in this part.
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