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# Proximate analysis and comparative evaluation of *Zamboanga peninsula* (ZamPen) native chicken

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## Abstract

*Zamboanga peninsula* (ZamPen) native chicken is a purified Joloano breed currently propagated by Western Mindanao State University (WMSU). With the limited data present in this species, this research attempted to establish baseline data it terms of its proximate composition. From there, a comparative study between its cut-up parts and sex (hen and rooster), as well as with other native chickens (in the Philippines as well as in other parts in Asia) was also conducted. Findings reveal that there are significant differences in the proximate composition in the selected cut-up parts for both hen and rooster ZamPen native chickens, except for its ash composition of hen. In addition, a no significant difference exists in the proximate composition in the selected cut-up parts between hen and rooster, except moisture composition in the legs, total fat content in the legs, wings, thighs, as well as fiber composition for all its cut-up parts. When compared to other native chicken breeds, with the exemption of the Baicheng-You breed; both ZamPen native chicken hen and rooster were found to have a higher proximate composition in terms of protein content for all of its cut-up parts. This implies then that the ZamPen native chicken is a promising source of protein for all its cut-up parts.

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## Introduction

The Philippine native chicken constitutes 46% of the total chicken population of the country, which is around 76 million heads. This industry provides livelihood in terms of additional income, food security, and opportunity to convert farm wastes and by-products into high value products. (Livestock Research Division, DOST-PACAARRD S&T Media Service, 2016). Research have shown that the native chicken meat is superior compared to broiler meat in terms of its sensory characteristics, as well as consumer preference in the preparation of various traditional dishes (Lambio *et al.*, 2000).

Among the various native chicken breeds in the Philippines (Banaba, Paraoakan, Bolinao, among others), the Zamboanga Peninsula (ZamPen) native chicken is a purified Joloano breed currently propagated by Western Mindanao State University (WMSU). Initial data gathered from this purified type of native chicken breed have shown positive results in terms of increased production of eggs, day-old chicks, and slaughter native chickens (Narvaez, 2016).

Limited studies have shown the proximate composition of Philippine native chicken meats present in the Philippines, (Fernandez, n.d.). This research then addresses the concern of expanding the data by presenting and comparing the cut-up part quality of hen and rooster ZamPen native chicken (on its several cut-up parts) in terms of proximate composition. In addition, this paper will also show a descriptive comparison of its obtained data with selected Philippine and Asian native chicken breeds.

## Materials and methods

*Research Protocol*

The procedures performed were in accordance to the guiding principles for the care and use of research animals. Standard laboratory safety procedures and waste disposal protocol were strictly followed.

*Equipment Used*

An analytical balance (Shimadzu AUX 320) and air oven (Thermo Fisher Scientific 6559) was utilized for the determination of moisture, protein digestor system (Velp Scientifica DKL-8) and digital burette (Biohit Biotrate) for the crude protein, solvent extractor (Velp Scientifica SER 148) and analytical balance (Shimadzu AUX 320) for the total fat analysis, and a furnace (Vulcan Dentsply Ceramco 3-550) and analytical balance (Shimadzu AUX 320) for the ash analysis. Furthermore, no equipment was utilized for the carbohydrate content determination for the meat samples.

*Reagents Used*

The purity of the reagents used in this study is in line with the protocols followed and were used directly without undergoing further purification.

*Sample Collection*

Collection was done following the simple random sampling method. Three (3) chicken samples (hen and rooster) of four (4) months old were collected separately at the ZamPen Native Chicken Breeding Station at the College of Agriculture, WMSU in San Ramon, Zamboanga City, Philippines.

*Preparation of Native Chicken Meat Samples*

The chickens were processed following the procedures used by Zahari, *et al.* (2021), with slight modifications. First, all the collected ZamPen native chickens (hen and rooster) were fasted for about eight (8) hours. Then, the chickens were separately slaughtered by cutting the trachea, esophagus, jugular veins, and carotid arteries using a sharp knife. The blood of the chickens was allowed to bleed out for about 7-10 minutes. The resulting carcasses were then immediately plucked out of its feathers manually, eviscerated and cut, deboned to afford its corresponding cut-up parts (leg, thigh, breast, wing, and skin). The resulting cut-up parts were further cut into small pieces using food chopper and were separately placed in previously cleaned, dried, and labeled bottles. These bottles (now containing the samples) were covered with a screw caps, wrapped with bond paper, placed in a resealable plastic bag, and then placed in cold storage at a temperature of $4^0$C. The samples were then brought to the Department of Science and Technology IX-Regional Science Testing Laboratory for proximate analysis.

*Proximate Analysis*

The procedure utilized in the proximate analysis of the prepared ZamPen native chicken samples were based on the Association of Analytical Chemists (AOAC), 20th edition (2016).

An AOAC 950.46 B method was used for the moisture analysis, AOAC 2001.11 for the crude protein analysis, AOAC 948.15 and 2003.05 for the total fat analysis, AOAC 920.153 for the ash analysis and AOAC 986.25 E for the carbohydrates content of the meat samples.

*Statistical Analysis*

Results obtained in proximate composition of ZamPen native chicken cut-up parts were analyzed using Analysis of Variance (ANOVA) and *t*-Test of R Studio Version 4.2.1. Significance was defined at 95% confidence level ($p< 0.05$).

**Results and discussion**

The ZamPen native chicken samples that were manually plucked, eviscerated, and were cut into different parts (leg, thigh, breast, wing and skin) for proximate analysis. A statistical comparison between hen and rooster as well as a descriptive comparison on the obtained data with other native chicken breeds were conducted.

*Proximate Composition of Cut-up Parts of ZamPen Native Chicken*

Table 1 shows the results of the proximate analysis of the selected cut-up parts (breast, legs, wings, thighs, and skin) of the ZamPen native chicken hen and rooster. Proximate analysis of red meats such as chevon and mutton (Baharuddin and Abdullah, 2015), sheep (Villatoro, *et al.*, 2021), beef (Najar-Villareal, *et al.*, 2019) and white meats such as turkey (Davis, *et al.*, 2022) and broiler (Sin-Young Park, *et al.*, 2021) reveal that moisture composition take the largest amount followed by protein which is more or less one third of it and then fat. The ash and the rest of the proximate components account for the few remaining amounts. ZamPen native chicken show no different results compared to the studied red and white meats.

The results of the proximate composition of boneless cut-up parts (breast, legs, wings, thighs, and skin) of both hen and rooster ZamPen native chickens and statistical comparison based on ANOVA P-values at 95% confidence level is shown in Table 1. The values of moisture, crude protein, total fat, ash, fiber, and carbohydrates varies from 61.25g/100g to 76.39g/100g, 19.72g/100g to 27.76g/100g, 0.21g/100 to 28.67g/100g, 0.64g/100g to 1.25g/100g, 0.17g/100g to 3.53g/100g and 0g/100g to 1.18g/100g, respectively.

**Table 1.** Results in the proximate analysis of ZamPen native chicken cut-up parts.

| Sample | Parameter*, g/100g | Boneless Cut-up Parts | | | | | *p*-value** |
|---|---|---|---|---|---|---|---|
| | | Breast | Legs | Wings | Thighs | Skin | |
| Hen | Moisture | 73.31 ± 0.70 | 74.27 ± 0.11 | 72.39 ± 0.03 | 75.00 ± 0.02 | 61.25 ± 5.13 | 0.0089 |
| | Crude Protein | 25.26 ± 0.75 | 23.97 ± 1.81 | 23.72 ± 0.22 | 22.43 ± 0.81 | 19.72 ± 1.46 | 0.0315 |
| | Total Fat | 0.90 ± 0.05 | 1.95 ± 0.06 | 1.70 ± 0.07 | 1.56 ± 0.08 | 22.92 ± 1.18 | 0.01 |
| | Ash | 1.18 ± 0.01 | 1.09 ± 0.07 | 1.15 ± 0.12 | 1.25 ± 0.11 | 0.64 ± 0.86 | 0.59 |
| | Fiber | 0.35 ± 0.03 | 0.20 ± 0.02 | 0.17 ± 0.01 | 0.28 ± 0.01 | 1.37 ± 0.27 | 0.0008 |
| | Carbohydrates | 0.00 | 1.04 ± 0.44 | 0.00 | 0.00 | 0.00 | 001 |
| Rooster | Moisture | 75.94 ± 3.41 | 76.39 ± 0.08 | 74.89 ± 1.03 | 74.85 ± 0.69 | 56.60 ± 2.93 | 0.0009 |
| | Crude Protein | 27.76 ± 1.50 | 23.43 ± 0.38 | 24.16 ± 0.01 | 22.59 ± 1.14 | 20.29 ± 0.68 | 0.004 |
| | Total Fat | 0.60 ± 0.05 | 0.75 ± 0.05 | 4.93 ± 0.11 | 0.21 ± 0.02 | 28.67 ± 2.05 | 0.01 |
| | Ash | 1.24 ± 0.01 | 1.13 ± 0.07 | 1.07 ± 0.07 | 1.17 ± 0.05 | 0.78 ± 0.05 | 0.003 |
| | Fiber | 1.01 ± 0.05 | 0.41 ± 0.04 | 0.34 ± 0.02 | 0.57 ± 0.01 | 3.53 ± 0.08 | 0.01 |
| | Carbohydrates | 0.00 | 0.00 | 0.00 | 1.18 ± 0.37 | 0.00 | 0.003 |

*Values presented are at n=2 (n= number of trials/parameter tested)

**Proximate parameters with P<0.05 are significantly different

The findings show that for both hen and rooster, significant differences are found in the proximate composition such as moisture, crude protein, total fat, ash, fiber and carbohydrates in the cut-up parts of the chicken, except for the ash content of the hen. It is noted that for both hen and rooster, the skin is the cut-up part which has the least amount of moisture, though the values obtained here are

higher compared to the values of moisture indicated in the Meat Products Handbook (Feiner, 2006). Also, the skin has the least amount of ash content, meaning the part of the chicken that has the least amount of inorganic substances which includes trace and major minerals (Ca, K, etc.). Moreover, the skin has the greatest amount of total fat which is the same as the data of the United States Department of Agriculture (USDA) (cited by Maloney, 2019). Finally, the findings also show that the skin has greatest amount of fiber composition which may be due to the fact that chicken skin is very rich in collagen and could be referred to as collagen fibers. In addition, it is observed that the cut-up parts with the highest and lowest crude protein content are the same for hen and rooster, that is breast and skin, respectively. The breast is lean and this could be the reason it has the highest amount of crude protein. The skin has a large amount of total fat and this could be the reason it has the lowest amount of crude protein.

*Comparison of the Proximate Composition of Cut-up Parts Between Hen and Rooster ZamPen Native Chicken*

The results of the proximate composition of the different cut-up parts of ZamPen native chicken between hen and rooster were also compared statistically at 95% confidence level ($p<0.05$) using t-test. The t-test results are presented in Table 2.

**Table 2.** Results of *t*- Test in the Proximate Composition of Cut-up Parts between Hen and Rooster ZamPen Native Chicken.

| Chicken Cut-up | Moisture | | | Crude Protein | | | Total Fat | | |
|---|---|---|---|---|---|---|---|---|---|
| Parts | df | *p*-Value | t | df | *p*-Value | t | df | *p*-Value | t |
| Breast | 1.083 | 0.4678 | -1.0685 | 1.467 | 0.2147 | -2.1015 | 1.9997 | 0.3076 | 5.5708 |
| Legs | 1.8208 | 0.003336 | -21.528 | 1.0874 | 0.7486 | 0.40879 | 1.894 | 0.002512 | 22.734 |
| Wings | 1.0015 | 0.1798 | -3.4401 | 1.0036 | 0.2187 | -2.7861 | 1.7211 | 0.001772 | -35.961 |
| Thigh | 1.0019 | 0.8168 | 0.29578 | 1.8058 | 0.8831 | -0.18861 | 1.212 | 0.01448 | 23.726 |
| Skin | 1.5918 | 0.4057 | 1.1133 | 1.4164 | 0.688 | -0.49277 | 1.6022 | 0.1017 | -3.4412 |
| Chicken Cut-up | Ash | | | Fiber | | | Carbohydrates | | |
| Parts | df | p-Value | t | df | p-Value | t | df | p-Value | t |
| Breast | 1.8343 | 0.0602 | -4.2163 | 1.5528 | 0.009991 | -16.423 | | N/A | |
| Legs | 1.9996 | 0.651 | -0.52671 | 1.5535 | 0.03655 | -7.0553 | | N/A | |
| Wings | 1.5983 | 0.5413 | 0.76433 | 1.8236 | 0.01282 | -10.2 | 1 | 18.64 | 3.3169 |
| Thighs | 1.347 | 0.4508 | 1.0359 | 1.4706 | 0.006351 | -25.491 | 1 | 0.1412 | -4.434 |
| Skin | 1.0081 | 0.854 | -0.23055 | 1.1827 | 0.04032 | -10.679 | | N/A | |

Findings show that chicken breast, wings, thigh and skin of hen and rooster have no significant difference in the values of moisture, crude protein, ash and carbohydrates. In addition, wings show no significant difference in total fat. This could be due to the same feed restrictions adopted in growing the chickens. For the leg part, hen and rooster show no significant difference only in crude protein, ash and carbohydrates whereas the moisture content of rooster is significantly higher compared to hen which means that the leg meat of rooster is leaner compared to the leg meat of hen. For the fiber content, rooster has higher composition than the hen in breast, legs, wings, thigh and skin. This could be due to higher slow and fast-twitch muscles fibers or connective tissues of rooster compared to hen as it is noted to walk, run and fly faster than hen. Moreover, it is noted that total fat of hen is significantly higher than rooster in the breast, legs and thigh. But for wings, rooster is significantly higher in fat contents than hen.

*Comparison Between the Proximate Composition of ZamPen Native Chicken and Proximate Composition Studies of Selected Asian and Philippine Native Chickens*

A comparison is done to ascertain the difference in the proximate composition results of hen and rooster ZamPen native chicken from other native chicken breeds. Table 3 shows the results of the proximate composition studies of selected Asian and Philippine native chicken cut-up parts. When compared to the local chicken strains, results show that the moisture of breast cut-up part of hen and rooster ZamPen native chickens are lower compared to moisture of

breast of Banaba, Joloanon, and Paraokan (however higher for rooster) and whole meat part of Bicol, Bolinao and Palawan. For the leg cut-up part, hen ZamPen native chicken has lower moisture content when compared to Banaba and Joloanon but higher compared to Paraokan. However, for rooster Zampen native chicken it is lower only when compared to Banaba and higher when compared to Joloananon and Paraokan. When compared to the whole meat part of Bicol, Bolinao and Palawan, both hen and rooster ZamPen native chickens show lower moisture content. For the skin part, results clearly show that hen and rooster ZamPen native chickens have quite lower moisture content compared to the skin part of Banaba, Joloanon, and Paraokan and even much lower moisture contents compared to the whole meat part of Bicol, Bolinao and Palawan.

For crude protein, Table 3 reveals that the breast and leg cut-up parts of hen and rooster ZamPen native chicken have higher crude protein content compared to Banaba, Joloanon, and Paraokan and the whole meat part of Bicol, Bolinao and Palawan. The observation is not the same for the skin part because as shown in Table 3, hen and rooster ZamPen native chickens have higher crude protein when compared only to Banaba, Joloanon, and Paraokan but not with the whole meat part of Bicol, Bolinao and Palawan.

**Table 3.** Proximate composition studies on cut -up parts from selected Asian native chickens.

| Country of Origin | Name of Chicken Breed* | Cut-up Part | Parameter, g/100g ± std. dev. | | | | Reference/s |
|---|---|---|---|---|---|---|---|
| | | | Moisture | Crude Protein | Total Fat | Ash | |
| China | Baicheng-You[c] | breast | 72.93 ± 0.53 | 30.24 ± 1.46 | - | 1.12 ± 0.12 | Sarsenbek, *et al.* (2013) |
| | | thigh | 75.16 ± 1.03 | 26.80 ± 0.67 | - | 1.09 ± 0.08 | Sarsenbek, *et al.* (2013) |
| Indonesia | Bali Indigenous chicken[c] | breast | 72.14 ± 0.19 | 22.32 ± 0.23 | 1.73 ± 0.05 | 1.39 ± 0.02 | Okarini, *et al.* (2013) |
| Japan | Hinai-jidori[a] | thigh | 71.3 ± 0.3 | 21.0 ± 0.4 | 6.3 ± 0.5 | - | Rikimaru and Takahashi (2010) |
| Taiwan | Taiwan Native Chicken[a] | breast | 74.73 ± 0.31 | 25.59 ± 0.60 | 1.77 ± 0.34 | - | Chumngoen and Tan (2015) |
| Thailand | Black-boned[c] | breast | 72.1 | 24.4 | 0.53 | 1.07 ± 0.02 | Jaturasitha (2008); Lengkidworraphiphat (2020) |
| | | thigh | 74.1 | 21.7 | 2.81 | - | Jaturasitha (2008) |
| | Thai Native (Thai)[c] | breast | 72.9 | 24.7 | 0.51 | 1.17 ± 0.02 | Jaturasitha (2008); Lengkidworraphiphat (2020) |
| | | thigh | 75.7 | 20.4 | 2.94 | - | Jaturasitha (2008) |
| Philippines | Banaba[c] | breast | 78.16 | 19.66 | 1.3 | 0.94 | Sumague, *et al.* (2016) |
| | | leg | 77.1 | 19.55 | 1.60 | 0.97 | Sumague, *et al.* (2016) |
| | | skin | 70.87 | 14.04 | 15.25 | 0.68 | Sumague, *et al.* (2016) |
| | Joloanon[c] | breast | 75.26 | 21.40 | 1.61 | 1.12 | Sumague, *et al.* (2016) |
| | | leg | 76.34 | 20.25 | 2.84 | 0.91 | Sumague, *et al.* (2016) |
| | | skin | 69.89 | 13.40 | 15.52 | 0.78 | Sumague, *et al.* (2016) |
| | Paraokan[c] | breast | 73.84 | 22.20 | 1.62 | 1.05 | Sumague, *et al.* (2016) |
| | | leg | 73.79 | 20.69 | 2.79 | 1.00 | Sumague, *et al.* (2016) |
| | | skin | 65.19 | 14.13 | 17.77 | 0.60 | Sumague, *et al.* (2016) |
| | Bicol[c] | whole | 77.57 | 21.77 | 2.27 | 1.01 | Magturo (2000) |
| | Bolinao[c] | whole | 77.07 | 20.79 | 2.25 | 1.02 | Magturo (2000) |
| | Palawan[c] | whole | 79.50 | 20.67 | 1.71 | 0.86 | Magturo (2000) |

*Sex of chicken used in study, as a) female, b) male, c) sex of chicken not specified, d) mixture of male and female

For total fat, it is demonstrated in Table 3 that the breast and leg cut-up parts of hen and rooster ZamPen native chickens have lower total fat compared to Banaba, Joloanon, and Paraokan as well as when compared to the whole meat part of Bicol, Bolinao and Palawan. However, the observation is opposite when it comes to skin cut-up part. It shows that the skin of hen and rooster Zampen native chickens have higher total fat content compared to the skin part of Banaba, Joloanon, and Paraokan and even much higher compared to the whole meat part of Bicol, Bolinao and Palawan.

For ash content, as gleaned from Table 3, the breast and leg cut-up parts of hen and rooster ZamPen native chickens, just like crude protein are again higher compared to the breast part of Banaba, Joloanon, and Paraokan and same as compared to the whole meat part of Bicol, Bolinao and Palawan. Finally, for the skin cut-up part, hen Zampen native chicken has lower ash content compared to Banaba and Joloanon and higher ash content compared to Paraokan. On the other hand, the rooster ZamPen native chicken has higher higher ash content compared to Banaba and Paraokan but has the same amount compared to Joloanon. However, when compared to the whole meat part of Bicol, Bolinao and Palawan, both hen and rooster ZamPen native chickens have lower ash contents.

The proximate composition results of this study are also compared to the proximate composition of Asian chicken strains namely Baicheng-You from China, Bali Indigenous chicken from Indonesia, Hinai-jidori from Japan, Taiwan Native chicken from Taiwan, and Black-Boned and Thai Native (Thai) from Thailand.

Tables 3 shows that the moisture content of breast cut-up part of hen and rooster Zampen native chickens have higher moisture contents compared to the breast part of the Baicheng-You, Bali Indigenous Chicken, Taiwan Native Chicken (except for hen), Black-boned and Thai Native (Thai). For the thigh cut-up part, the moisture content of hen and rooster Zampen native chickens are higher compared to Hinai-jidori and Black-boned and lower compared to Baicheng-You and Thai Native (Thai).

Moreover, on the breast cut-up part, the same Table presents that hen and rooster ZamPen native chickens have higher crude protein compared to Bali Indigenous Chicken, Taiwan Native Chicken but not for hen Zampen native chicken, Black-boned and Thai Native (Thai). However, both hen and Zampen native chickens have lower crude protein composition compared to Baicheng-You. For the thigh cut-up part, the crude protein composition of hen and rooster ZamPen native chickens are again higher compared to Hinai-jidori, Black-boned and Thai Native (Thai) but lower compared to Baicheng You.

Furthermore, the total fat on the breast cut-up part shows that hen and rooster Zampen native chickens have higher total fat contents compared to Black-boned and Thai Native (Thai) but have lower total fat contents compared to Bali Indigenous chicken and Taiwan Native Chicken. For the thigh cut-up part, both hen and rooster Zampen native chickens have lower total fat contents compared to Hinai -jidori, Black-boned and Thai Native (Thai). Finally, for ash composition, hen and rooster ZamPen native chickens have lower ash composition in the breast cut-up part compared to Baicheng-You, Bali Indigenous Chicken, Black-boned and Thai Native (Thai) and have higher ash composition compared to Baicheng-You on the thigh cut-up part.

**Conclusion**

A baseline data for the proximate analysis for the ZamPen native chicken was established. Based from the results, the cut-up parts of ZamPen native chickens, just like fresh meats from different sources, are high in moisture content. This is followed by crude protein and the rest of the few amounts are total fat, ash, fiber, and carbohydrates. Results from the statistical analysis show that there is are significant differences in the proximate composition in the selected cut-up parts for both hen and rooster ZamPen native chickens, except ash composition of hen. In addition, there are no significant differences in the proximate composition in the selected cut-up parts between hen and rooster, except moisture composition in the legs, total fat content in the legs, wings, and thighs as well as fiber composition in the breast, legs, wings, thighs and skin. When compared to other Philippine native chickens, both hen and rooster ZamPen native chickens have higher proximate composition. When compared to selected Asian native chickens, both ZamPen native chickens (hen and rooster) have a higher crude protein contents of its cut-up parts compared to other selected Asian chickens (except for Baicheng-You).

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**Declaration of interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence or any competing interests in the work reported in this paper.

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