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# The addition of calcium soap in the ration on the performance, carcass and abdominal fat of native chickens

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## Abstract

This study aims to examine the effect of adding calcium soap (Ca-PFAD) to feed on performance, carcass and abdominal fat in native chickens. A total of two hundred and forty 6 week old native chickens were obtained from commercial native chicken farming with an average body weight of 662.52±21.75 g. All chickens were kept in a room with controlled environment. A total of 240 native chickens were divided randomly into four treatments, namely control feed without Ca-PFAD supplement as control (C0); feed supplemented with 2% Ca-PFAD (C1); added feed with 4% Ca-PFAD (C2); and diet supplemented with 6% Ca-PFAD. All diets were isocaloric and isonitrogen. Each treatment had six replications and each replication had 60 chickens. The results showed that the addition of 2-4% Ca-PFAD in feed significantly (P<0.05) improved performance, carcasses, carcass percentage and carcass meat percentage. The amount of pad fat and abdominal fat in chickens decreased significantly (P<0.05) with the addition of 2% Ca-PFAD in the feed. It can be concluded that the addition of 2% calcium soap (Ca-PFAD) in feed can improve performance and carcass quality in native chickens, on the other hand it can reduce the amount of abdominal fat.

**Keywords:** Abdominal Fat; Carcass; Native Chicken; Performance

## 1. Introduction

Native chicken is one of the local chickens from Indonesia which is very easy to adapt. Native chickens have an adaptive nature that can adapt to situations and weather changes. Native chicken meat plays an important role in meeting people's nutritional needs, because it contains a lot of protein and other substances such as fat, minerals, vitamins which are important for smooth metabolic processes in the body. Native chicken meat has a delicious taste, distinctive aroma and low fat content. This makes Native chicken widely cultivated by the community. One of the factors in improving performance and producing good carcass quality in poultry is by providing quality rations. Rations have an important role for livestock for basic needs, growth and meat production.

Efforts to improve the performance and quality of native chicken meat, as well as reduce production costs, require utilizing waste. One of them is waste from palm oil processing combined with calcium. Palm fatty acid distillate (PFAD) as a by-product of palm oil processing has not been widely utilized, and is an alternative feed for poultry [1].

The refining process will produce refined palm oil as the main product and palm fatty acid distillate (PFAD) as a side product that has not been widely utilized [1].

Palm fatty acid distillate (PFAD) contains very high levels of free fatty acids and is often used in making soap and detergent. It was also reported that the addition of calcium aims to ensure that the fat given as a supplement to livestock does not interfere with the digestion of poultry. The main composition of PFAD consists of free fatty acids, so the esterification reaction is the right choice [2].

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The squalene compound content in PFAD is quite high, namely 1.03% [3]. Apart from squalene, PFAD also contains high levels of free fatty acids and glycerides, as well as tocopherols, tocotrienols, and phytosterols [2].

Providing 1-3% calcium soap in the ration significantly increased the final body weight and weight gain of ducks[4]. A similar thing was reported by[5] that the addition of calcium soap in the ration can increase carcass weight and increase the percentage of carcass meat in ducks. Anggreni et al.[6] reported that giving calcium in commercial rations as much as 3% could increase the percentage of meat and reduce subcutaneous fat in broilers and the results of research by[7] giving 2-3% calcium oil in commercial rations can reduce slaughter weight and abdominal fat in broilers. This study aims to examine the effect of adding calcium soap (Ca-PFAD) to feed on performance, carcass and abdominal fat in native chickens aged 6-12 weeks.

## 2. Material and methods

### 2.1. Animal treatments and experimental design

This research was carried out at the Research Station, Faculty of Animal Husbandry, Udayana University, Denpasar, Indonesia. A total of two hundred and forty 6 weeks old native chickens were obtained from commercial native chicken farming with an average body weight of 662.52±21.75 g. All chickens were kept in a room with controlled environment. A total of 240 native chickens were divided randomly into four treatments, namely control feed without Ca-PFAD supplement as control (C0); feed supplemented with 2% Ca-PFAD (C1); added feed with 4% Ca-PFAD (C2); and diet supplemented with 6% Ca-PFAD. All diets were isocaloric and isonitrogen. Each treatment had six replications and each replication had 60 chickens. All chickens are placed in cages measuring 200x100x50 $cm^3$, which contains ten chickens. The basic diet was based on chicken nutritional requirements[8]. The feed given in this study was commercial feed CP 511, which was produced by PT. Charoen Pokphand Tbk., Indonesia

Birds were weighed first and at the end of the experiment. Feed intake (FI) was determined every week. Feed conversion ratio (FCR), calculated in kg FI/kg LWG, was recorded for each pen throughout the experiment.

At the end of the study (12 weeks), the birds were slaughtered. Four chickens per unit in the experiment that was close to the average live body weight (BW) is selected. After being weighed, the feet were then tied to be slaughtered. Next, the carcass and abdominal fat were observed. Chickens were weighed to the nearest gram, after the chickens had been fasted on food for 12 hours with free access water, weighed again, and slaughtered by cutting the neck. Next, immediately remove the blood through cutting the carotid artery and slicing part of the neck manually. After all the blood has come out, the dead chicken was then dipped in hot water, then the feathers were removed, the digestive tract and internal organs were removed, then the head and legs were cut off. Carcass without chicken innards weighed, and expressed as carcass weight. Chicken carcass weight was the weight of the slaughtered chicken minus feathers, trachea, esophagus, proventriculus, ventriculus, intestine, spleen, pancreas, liver, gallbladder, and reproductive organs[9]. Carcass percentage was the ratio between carcass weight and live weight multiplied by 100%.

### 2.2. The calcium soap (Ca-PFAD)

The calcium soap (Ca-PFAD) added to the ration mixture in this study was calcium soap made from palm oil waste in solid form, such as lime flour. Calcium soap flour (Ca-PFAD) was produced by the Faculty of Mathematics and Natural Sciences, Chemical Engineering, Bandung Institute of Technology (ITB), Indonesia. The nutrient content of calcium soap (Ca-PFAD) was: 54.24% extract without nitrogen; 97.32% total digestible nutrients; 0.80% crude protein; 31.30% ether extract; 3.0% Ca; and 6562 GE kcal/kg[1].

All data were analyzed using one-way analysis (ANOVA) to determine differences between treatments. If the difference is significant ($P \leq 0.05$) was found, then further analysis was carried out using Duncan's multiple range test.

## 3. Results and discussion

### 3.1. Performance of native chickens

The effect of adding calcium soap (Ca-PFAD) to native chicken feed from 6-12 weeks of age on final body weight (BW), body weight gain (LWG), feed consumption (FI), and feed efficiency (FI/LWG) is presented in Table 1. Chicken groups C1 and C2 had final body weights 10.73% and 6.01% significantly ($P \leq 0.05$) than group C0 chickens. Likewise with body weight gain: 21.02% and 11.84% were significantly ($P \leq 0.05$) higher than the control chicken group (C0). The addition of calcium soap at a level of 2-6% in feed did not have a significant effect ($P \geq 0.05$) on feed consumption.

Feed conversion ratio (FCR) is a comparison between FI and LWG. The lower the FCR value, the more efficient the use of feed to produce body weight gain in the same unit of time. The addition of calcium soap (Ca-PFAD) at a level of 2% in the feed (chicken group C1) showed the highest feed efficiency compared to other chicken groups, and was statistically significantly different (P≤0.05).

**Table 1** Effect of adding calcium soap (Ca-PFAD) to native chicken feed from 6-12 weeks of age on chicken performance

| **Variable** | **Level of Ca-PFAD in the ration (g/100g)** | | | | **SEM[1)]** |
|---|---|---|---|---|---|
| | 0 | 2 | 4 | 6 | |
| Initial body weight (g/head) | 661.95[a] | 663.61[a] | 656.67[a] | 659.17[a] | 1.19 |
| Final body weight (g/head) | 1433.89[c2)] | 1597.78[a] | 1520.00[b] | 1415.83[c] | 19.80 |
| Live weight gains (g/head/6 weeks) | 771.94[c] | 934.17[a] | 863.34[b] | 756.67[c] | 20.15 |
| Feed consumption (g/head/6 weeks) | 2433.10[a] | 2663.86[a] | 2614.90[a] | 2360.50[a] | 92.42 |
| *Feed Conversion Ratio* (FI/LWG) | 3.15[b] | 2.85[a] | 3.03[b] | 3.12[b] | 0.05 |

[a,b,c]Means within rows with different superscripts are significantly different (P ≤0.05)

The addition of 2% and 4% calcium soap in the feed gave the highest increase in body weight compared to the control. This is due to an increase in the energy level of PFAD which is balanced by the content of phytochemical compounds in PFAD, and the presence of Ca minerals. Increased excretion of magnesium, zinc, manganese, and phosphorus is often associated with increased calcium minerals in the diet[11]. The Ca mineral in calcium soap can increase metabolism, because the Ca mineral is an activator of several enzymes, such as pancreatic lipase, acid phosphatase, cholinesterase, and succinic dehydrogenase.

An increase in calcium minerals in feed causes digestive disorders and nutrient absorption through the formation of insoluble elements in the chicken's digestive tract, thereby reducing the utilization of nutrients, such as phosphorus minerals[11]. High Ca mineral concentrations in broiler chicken diets produce negative effects on chicken performance (chicken Group C3). Feed containing 1.25% calcium minerals significantly increases LWG and food digestibility compared to feed containing 1.5% calcium minerals and feed containing 1% calcium [12].

Adding medium chain fatty acids (MCFA) to broiler diets to replace soybean oil and animal fat has been shown to improve feed efficiency. Vitamin E as an antioxidant can improve livestock's immune system and reduce stress in livestock so that it can influence livestock production[13].

Decreased availability of calcium minerals and increased excretion of magnesium, zinc, manganese, and phosphorus are often associated with increased calcium minerals in the diet[10]. Increased calcium in the diet causes digestive and absorption disorders through the formation of insoluble elements in the intestinal tract, thereby reducing the utilization of nutrients such as phosphorus[11].

### 3.2. Carcass characteristics and abdominal-fat

In Table 2, the carcass characteristics and body fat distribution of 12 week old native chickens are presented as a result of giving calcium soap (Ca-PFAD). Carcass weight, carcass percentage and carcass meat percentage in chicken groups C1 and C2 were significantly (P≤0.05) higher compared to chicken groups C0 and C3. Likewise, the weight of breast, thigh, drumstick and wing between treatments showed significant differences (P≤0.05).

The amount of carcass meat (g/100 g carcass) increased significantly (P≤0.05) with the provision of calcium soap in the feed of C1, C2 and C3 chicken groups, namely: 0.52%; 1.80%; and 0.52% significantly (P≤0.05) higher than Group C0 chickens.

Providing calcium soap (Ca-PFAD) in feed apparently had no significant impact (P≥0.05) on the amount of mesentiric-fat and ventricular-fat. However, at a level of 2% calcium soap in the feed (chicken group C1), the amount of pad-fat and abdominal-fat decreased significantly (P≤0.05), namely: 10% and 10% lower than the control (chicken group C0 ).

**Table 2** Effect of giving rations containing calcium soap (Ca-PFAD) on carcass characteristics and abdominal fat of native chickens.

| Variable | Level of Ca-PFAD in the ration (g/100g) | | | | SEM |
|---|---|---|---|---|---|
| | 0 | 2 | 4 | 6 | |
| Carcass weight (g/head) | 959.83$^{c}$ | 1084.33$^{b}$ | 1089.67$^{a}$ | 961.50$^{c}$ | 0.74 |
| Carcass percentage (%) | 69.32$^{b}$ | 69.51$^{a}$ | 69.58$^{a}$ | 69.02$^{b}$ | 0.13 |
| Percentage of carcass meat (%) | 61.80$^{c}$ | 62.12$^{b}$ | 62.91$^{a}$ | 62.12$^{b}$ | 0.07 |
| *Carcass part cuts (g/100 g carcass)* | | | | | |
| Breast | 24.89$^{b}$ | 23.96$^{d}$ | 25.71$^{a}$ | 24.62$^{c}$ | 0.03 |
| Thigh | 18.52$^{b}$ | 18.90$^{a}$ | 18.23$^{c}$ | 17.96$^{d}$ | 0.05 |
| Drumstick | 16.28$^{b}$ | 16.70$^{a}$ | 16.90$^{a}$ | 16.03$^{c}$ | 0.07 |
| Wing | 18.84$^{a}$ | 18.64$^{b}$ | 17.53$^{c}$ | 17.44$^{c}$ | 0.06 |
| *Body fat distribution (g/100 body weight)* | | | | | |
| Pad-fat | 1.34$^{a}$ | 0.70$^{b}$ | 1.22$^{a}$ | 1.27$^{a}$ | 0.03 |
| Mesenteric-fat | 0.21 | 0.15 | 0.17 | 0.22 | 0.02 |
| Ventricular-fat | 0.53 | 0.51 | 0.53 | 0.57 | 0.02 |
| Abdominal-fat | 2.08$^{a}$ | 1.36$^{c}$ | 1.92$^{b}$ | 2.06$^{a}$ | 0.03 |

$^{a,b,c}$Means within rows with different superscripts are significantly different (P ≤0.05)

One of the free fatty acids contained in PFAD is linoleic acid. Linoleic acid is an omega-6 fatty acid, meaning it is unsaturated, with a double bond that occurs at the sixth carbon atom. The main effect of conjugated linoleic acid (CLA) on chicken performance is to reduce fat accumulation and increase muscle growth. CLA repartitions body fat to lean and improves feed efficiency[14]. Medium chain fatty acids (MCFA) are more effectively absorbed and metabolized than saturated long chain fatty acids, and have antimicrobial properties in poultry[15]. The research results of[16] reported that the use of waste palm oil in poultry livestock can increase body weight and carcass weight compared to without adding palm fatty acids. Meanwhile, Anggreani et al.[6] stated that the fatty acids in calcium soap can be used as an energy source for poultry feed to support improving carcass quality.

Broiler chickens fed rations with added medium chain fatty acids (MCFA) had a significantly greater final body weight. Carcass cut weights (breast, drumsticks, and wings) were greater than in control broilers[17]. Abdullah et al.[18] reported that the addition of 1.5% calcium in feed significantly reduced carcass weight compared to controls. The carcass percentage was lower in birds fed 2% calcium or 3% calcium compared to birds fed 1% calcium[19]. El-Faham et al.[20] reported that reducing the mineral Ca in feed from 0.9 to 0.45% significantly reduced body weight, carcass weight and carcass percentage of chickens.

Research by[16] reported that giving Ca-PFAD in the ration up to 15% had no effect on LWG and carcasses of chickens. The addition of conjugated linoleate in feed can induce a rapid and significant decrease in fat accumulation and increase in protein deposition[21]. It also reduces feed intake and improves feed efficiency. CLA has been shown to reduce the fat content of pork carcasses[22]. The use of different fats can affect broiler performance and carcass characteristics, due to differences in fatty acid chain length, degree of saturation and degree of esterification[9]. In addition, dietary fat increases the absorption and utilization of fat-soluble vitamins, increases the palatability of the diet, reduces pulverulence, and increases the efficiency of energy consumed[23,24, 24], as well as reducing the flow rate of digesta in the digestive tract, thus providing space for longer and increased efficient absorption of nutrients[23].

## 4. Conclusion

It can be concluded that the addition of 2% calcium soap (Ca-PFAD) in native chicken feed from 6-12 weeks of age can increase chicken performance and carcass weight, on the other hand, reduce the amount of abdominal fat, thereby reducing post-harvest losses because abdominal fat is the part that wasted (non-carcass).

## Compliance with ethical standards

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*Disclosure of conflict of interest*

All authors have no conflict of interest with the manuscript or product mentioned in the research materials presented.

*Statement of ethical approval*

This research has been approved by the animal ethics commission, from the Faculty of Veterinary Medicine, Udayana University, Denpasar, Indonesia

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