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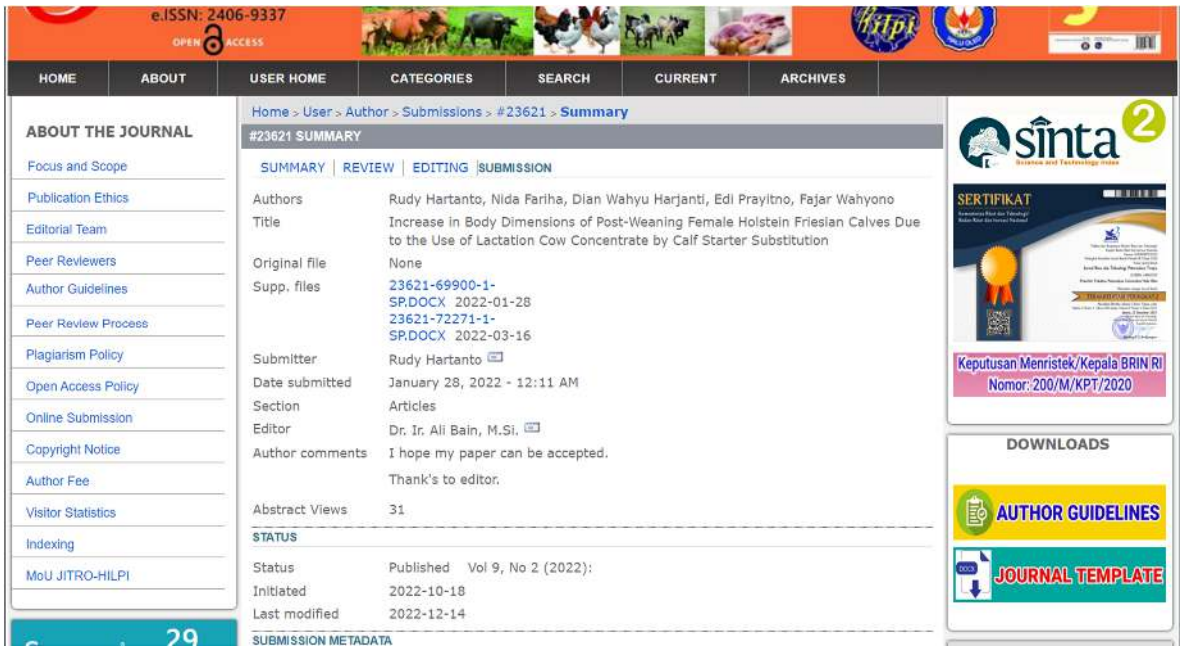

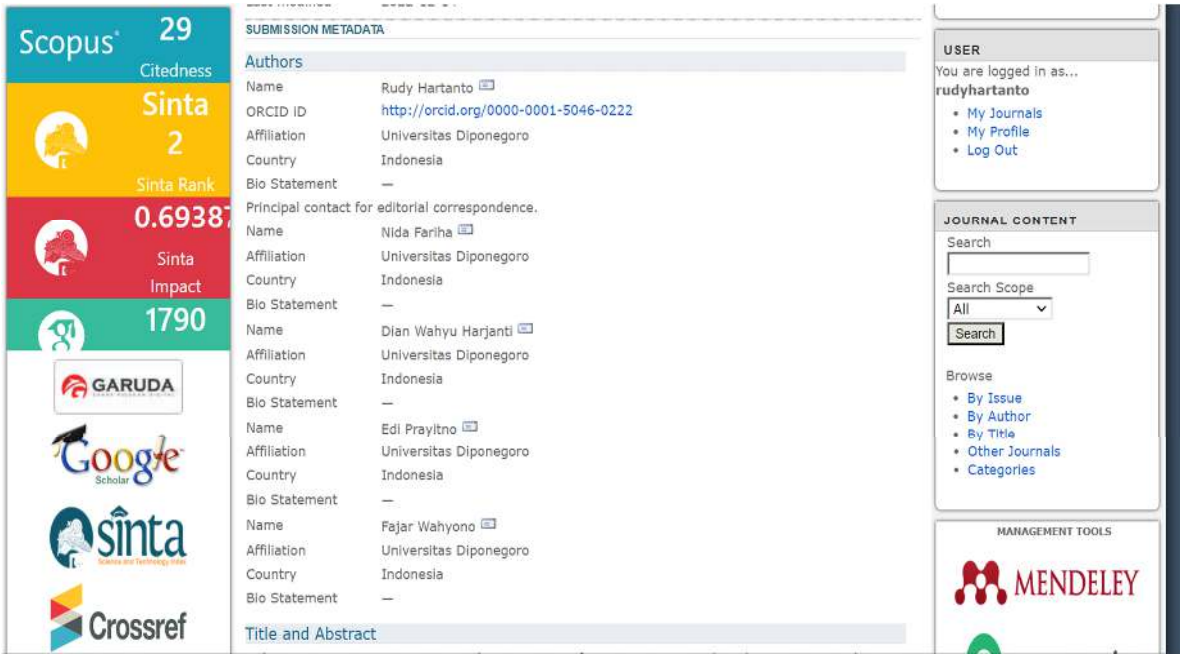
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Name Rudy Hartanto
ORCID ID http://orcid.org/0000-0001-5046-0222
Affiliation Universitas Diponegoro
Country Indonesia
Bio Statement —
Principal contact for editorial correspondence.
Name Nida Fariha
Affiliation Universitas Diponegoro
Country Indonesia
Bio Statement —
Name Dian Wahyu Harjanti
Affiliation Universitas Diponegoro
Country Indonesia
Bio Statement —
Name Edi Prayitno
Affiliation Universitas Diponegoro
Country Indonesia
Bio Statement —
Name Fajar Wahyono
Affiliation Universitas Diponegoro
Country Indonesia
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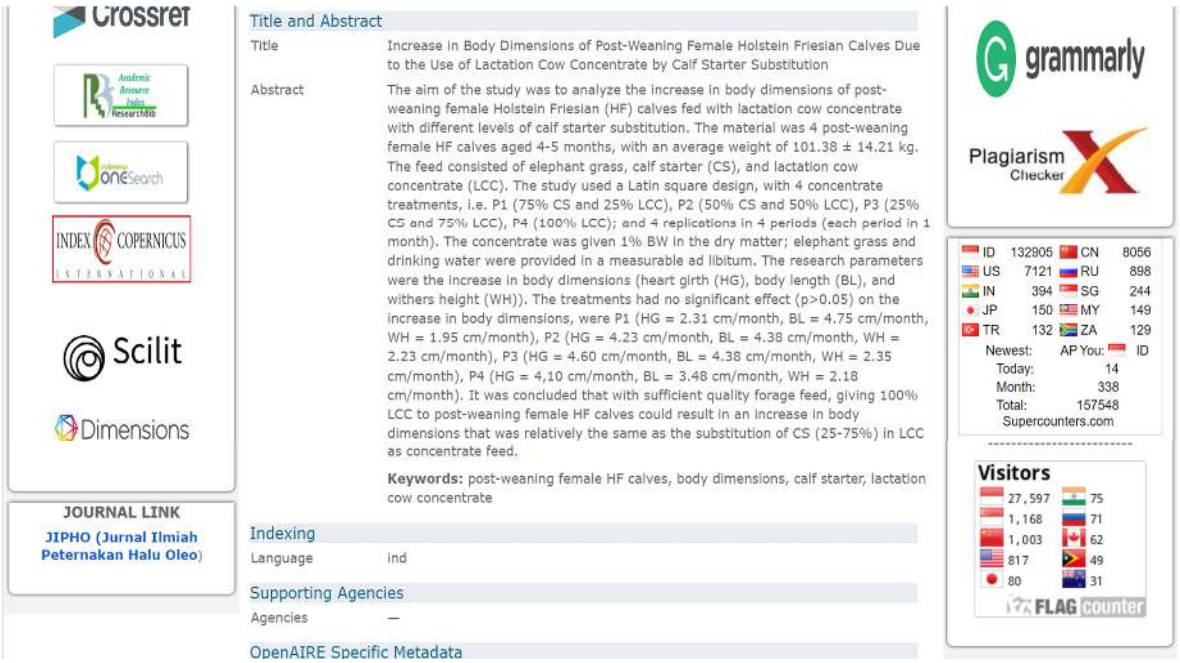
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Title and Abstract
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Abstract The aim of the study was to analyze the increase in body dimensions of post-weaning female Holstein Friesian (HF) calves fed with lactation cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass, calf starter (CS), and lactation cow concentrate (LCC). The study used a Latin square design, with 4 concentrate treatments, i.e. P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), P4 (100% LCC); and 4 replications in 4 periods (each period in 1 month). The concentrate was given 1% BW in the dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body dimensions (heart girth (HG), body length (BL), and withers height (WH)). The treatments had no significant effect (p>0.05) on the increase in body dimensions, were P1 (HG = 2.31 cm/month, BL = 4.75 cm/month, WH = 1.95 cm/month), P2 (HG = 4.23 cm/month, BL = 4.38 cm/month, WH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, WH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, WH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% LCC to post-weaning female HF calves could result in an increase in body dimensions that was relatively the same as the substitution of CS (25-75%) in LCC as concentrate feed.
Keywords: post-weaning female HF calves, body dimensions, calf starter, lactation cow concentrate
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# Pertambahan Ukuran Tubuh Pedet *Friesian Holstein* Betina Lepas Sapih Akibat Penggunaan Konsentrat Sapi Perah Yang Disubstitusi *Calf Starter*

## *Increase in Body Measurements of Post-Weaning Female Holstein Friesian Calves Due to the Use of Concentrated Dairy Cows Substituted by Calf Starter*

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Departemen Peternakan, Fakultas Peternakan dan Pertanian, Universitas Diponegoro
Kampus drh. Soejono Koesoemowardojo, Tembalang, Semarang 50275

*Email korespondensi: rudyharta@gmail.com; rudyhartanto@lecturer.undip.ac.id

## ABSTRAK

Penelitian bertujuan untuk menganalisis pertambahan ukuran tubuh pedet *Friesian Holstein* (FH) betina lepas sapih yang diberi konsentrat sapi perah dengan substitusi *calf starter* yang berbeda level. Materi adalah 4 ekor pedet FH betina lepas sapih umur 4 – 5 bulan, BB rata-rata 101,38 ± 14,21 kg. Pakan berupa rumput gajah, *calf starter* serta konsentrat sapi laktasi. Penelitian menggunakan rancangan bujur sangkar latin (RBSL), dengan 4 perlakuan konsentrat yaitu P1 (75% *calf starter* dan 25% konsentrat sapi laktasi), P2 (50% *calf starter* dan 50% konsentrat sapi laktasi), P3 (25% *calf starter* dan 75% konsentrat sapi laktasi), P4 (100% konsentrat sapi laktasi); dan 4 ulangan dalam 4 periode (setiap periode berlangsung 1 bulan). Konsentrat diberikan 1% BB dalam bahan kering; rumput gajah serta air minum diberikan secara *adlibitum* terukur. Parameter penelitian adalah pertambahan ukuran tubuh (lingkar dada (LD), panjang badan (PB), tinggi pundak (TP)). Data dianalisis menggunakan Anova. Hasil menunjukkan perlakuan tidak berpengaruh nyata (P>0,05) terhadap pertambahan ukuran tubuh pedet FH betina lepas sapih. Pertambahan ukuran tubuh pada P1 (LD = 2,30 cm/bulan, PB = 4,75 cm/bulan, TP = 1,95 cm/bulan), P2 (LD = 4,20 cm/bulan, PB = 4,38 cm/bulan, TP = 2,23 cm/bulan), P3 (LD = 4,60 cm/bulan, PB = 4,38 cm/bulan, TP = 2,35 cm/bulan), P4 (LD = 4,10 cm/bulan, PB = 3,48 cm/bulan, TP = 2,18 cm/bulan). Disimpulakan bahwa dengan pakan hijauan berkualitas dalam jumlah cukup, pemberian 100% konsentrat sapi laktasi pada pedet FH betina lepas sapih dapat menghasilkan pertambahan ukuran tubuh yang relatif sama dengan pemberian substitusi calf starter (25-75%) pada konsentrat sapi perah sebagai pakan konsentratnya.

**Kata Kunci** : pedet FH betina lepas sapih, ukuran tubuh, calf starter, konsentrat

## ABSTRACT

The aim of the study was to analyze the increase in body measurements of post-weaning female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass,

calf starter and lactating cow concentrate. The study used a Latin square design (RBSL), with 4 concentrate treatments, namely P1 (75% calf starter and 25% lactating cow concentrate), P2 (50% calf starter and 50% lactating cow concentrate), P3 (25% calf starter and 75% lactating cow concentrate), P4 (100% lactating cow concentrate); and 4 replications in 4 periods (each period in 1 month). Concentrate is given 1% BW in dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body measurements (heart girth (HG), body length (BL) and shoulder height (SH)). Data were analyzed using ANOVA. The results showed that the treatment had no significant effect (P>0.05) on the increase in body size of post-weaning female HF calves. Increase in body measurements at P1 (HG = 2.30 cm/month, BL = 4.75 cm/month, SH = 1.95 cm/month), P2 (HG = 4.20 cm/month, BL = 4.38 cm/month, SH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, SH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, SH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% lactating cow concentrate to post-weaning female HF calves could result in an increase in body measurements that was relatively the same as the substitution of calf starter (25-75%) in lactating cow concentrate as concentrate feed.

**Keywords:** post-weaning female HF calves, body measurements, calf starter, concentrate

## PENDAHULUAN

Pemberian pakan dan minum serta kesehatan pedet merupakan faktor penting yang perlu diperhatikan guna mendapatkan pertumbuhan pedet yang baik, dimasa pra sapih maupun lepas sapih. Pedet yang sudah lepas sapih tidak mendapatkan susu dari induknya dan memenuhi kebutuhan nutrisinya secara penuh dari hijauan dan konsentrat (Kusumawati *et al*., 2018; Atabany *et al.*, 2020). Pedet mulai dapat disapih saat berumur 8 minggu, yaitu setelah mampu mengkonsumsi pakan starter 0,5 – 0,68 kg /hari, tetapi penyapihan di umur ini memiliki resiko kematian pedet yang tinggi sehingga pedet pada umunya disapih saat umur 3 bulan (NRC, 2001; Prihantoro *et al.,* 2012). Saat lepas sapih, pedet memasuki fase awal pertumbuhan, sehingga sebagian besar nutrisi yang dikonsumsi akan digunakan untuk pertumbuhan seperti pembesaran kerangka tubuhnya (Imran *et al*, 2012; Welboren *et al*., 2018).

Pembentukan ukuran tubuh pedet betina saat lepas sapih sangat perlu diperhatikan karena pedet betina yang dari awal sudah mempunyai ukuran tubuh ideal, akan menjadi

indukan yang ideal pula. Selain pertambahan bobot badan, pertambahan ukuran tubuh (lingkar dada, tinggi pundak, panjang tubuh) pada pedet lepas sapih juga merupakan ukuran tampilan atau performens pedet (Hardiono *et al*., 2016; Rotondo *et al*., 2021). Pedet saat lepas sapih sebaiknya memiliki ukuran lingkar dada 96 cm dan tinggi badan 75 cm, supaya nantinya dapat memenuhi target lingkar dada 155 cm dan tinggi badan 115 cm pada saat masuk usia 15 bulan untuk IB pertama kali (Alim dan Hidaka, 2002). Pembentukan ukuran tubuh ini dipengaruhi oleh kecukupan akan kebutuhan nutriennya. Pedet lepas sapih biasanya diberi pakan hijauan berkualitas tinggi dan konsentrat yang diformulasikan untuk memenuhi kebutuhan nutrisi serta meningkatkan bobot badannya (American Society of Animal Science, 2020).

Namun pada praktik di lapangan, pemberian pakan untuk pedet lepas sapih belum diperhatikan dengan baik oleh para peternak kecil. Umumnya peternakan rakyat memberikan konsentrat sapi laktasi pada pedet dengan pertimbangan harga konsentrat yang lebih murah. Konsentrat sapi laktasi minimal memiliki kandungan PK sebesar 14% dan TDN 68%, sedangkan pada *calf starter* kadungan PK 16-21% dan TDN 70-80% (BSN, 2017). Padahal kebutuhan nutrisi pedet mulai dari lepas sapih hingga dara berbeda dengan kebutuhan sapi dewasa, sehingga pedet perlu diberikan pakan yang berbeda pula dengan sapi dewasa.

Substitusi *calf starter* pada konsentrat sapi laktasi dilakukan dengan tujuan untuk meningkatkan kualitas nutrien pada pakan konsentrat yang diberikan pada pedet lepas sapih. *Calf starter* berbeda dengan konsentrat sapi laktasi baik secara fisik maupun kualitasnya (Mukodiningsih *et al.*, 2012). Pedet lepas sapih yang mendapatkan pakan yang lebih berkualitas akan menghasilkan performen dalam ukuran tubuh yang lebih baik juga. Bobot badan dan ukuran tubuh yang lebih besar pada umur yang sama menunjukkan adanya pertumbuhan yang lebih baik (Turiello *et al*., 2016; Nemati *et al*., 2016).

Penelitian ini bertujuan untuk mengetahui dan mengkaji tentang pertambahan ukuran tubuh pedet FH betina lepas sapih yang diberi konsentrat sapi perah dengan substitusi *calf starter* yang berbeda level.

## MATERI DAN METODE

### Materi

Materi yang digunakan yaitu 4 ekor pedet FH betina lepas sapih umur 4 – 5 bulan dengan BB rata-rata 101,38 ± 14,21 kg. Pedet dipelihara dalam kandang metabolik selama penelitian berlangsung. Pita ukur merek 300 cm dengan keakuratan 0,1 cm dan tongkat ukur dari *stainless steel* 1,5 m dengan kepekaan 0,1 cm untuk mengukur dimensi tubuh ternak. Pakan yang digunakan yaitu rumput gajah, konsentrat sapi laktasi (KSL), dan *calf starter* (CS) produksi Teaching Farm FPP Undip.

### Metode

Pakan yang diberikan berupa hijauan dan konsentrat perlakuan yang disesuaikan dengan kebutuhan BK ternak. Konsentrat perlakuan (dalam BK) diberikan sebanyak 1% BB dalam dua kali pemberian, yaitu pagi pukul 06.00 dan sore pukul 15.00. Hijauan dan air minum diberikan secara *ad libitum* terukur. Konsentrat perlakuan terdiri atas P1 (75% CS dan 25% KSL), P2 (50% CS dan 50% KSL), P3 ( 25% CS dan 75% KSL), dan P4 (100% KSL). Kandungan nutrisi pakan yang diberikan terlihat pada tabel 1. Rancangan penelitian yang digunakan yaitu rancangan bujur sangkar latin (RBSL) dengan 4 perlakuan dan 4 periode.

Pemberian dan sisa dari pakan serta air minum pada ternak dicatat di buku catatan secara rutin. Penelitian dilakukan dalam 4 periode, setiap periode dilakukan selama 30 hari pengamatan. Parameter yang diukur yaitu lingkar dada (LD), panjang badan (PB), tinggi

pundak (TP). Pengukuran ukuran tubuh dilakukan pada awal dan akhir periode, dilanjutkan istirahat selama 5 hari, dan dilanjutkan ke periode berikutnya.

Tabel 1. Kandungan Nutrien Pakan

| | Air | Abu | TDN | PK | LK | SK | Ca | P |
|---|---|---|---|---|---|---|---|---|
| | ---------- % ---------- | | | | | | | |
| Konsentrat Sapi Laktasi | 9,42 | 9,90 | 64,91 | 16,40 | 6,42 | 26,87 | 0,51 | 0,56 |
| *Calf starter* | 11,17 | 12,32 | 76,13 | 19,70 | 5,25 | 8,74 | 0,08 | 0,50 |
| Rumput Gajah | 7,73 | 13,31 | 58,5 | 12,13 | 2,17 | 28,64 | 0,30 | 0,27 |
| Konsentrat P1 | 10,73 | 11,71 | 73,32 | 18,87 | 5,54 | 13,27 | 0,18 | 0,51 |
| Konsentrat P2 | 10,29 | 11,11 | 70,52 | 18,05 | 5,83 | 17,80 | 0,29 | 0,53 |
| Konsentrat P3 | 9,86 | 10,50 | 67,71 | 17,25 | 6,13 | 22,33 | 0,40 | 0,54 |
| Konsentrat P4 | 9,42 | 9,90 | 64,91 | 16,40 | 6,42 | 26,87 | 0,51 | 0,56 |

**Analisis Data**

Semua data dianalisis menggunakan analisis ragam (ANOVA). Jika terdapat pengaruh perlakuan maka dilanjutkan uji Duncan.

## HASIL DAN PEMBAHASAN

Hasil penelitian pengaruh pemberian substitusi *calf starter* pada konsentrat sapi laktasi terhadap pertambahan ukuran tubuh pedet FH betina lepas sapih disajikan pada Tabel 2. Perlakuan substitusi *calf starter* pada konsentrat sapi laktasi (P1, P2, P3, dan P4) tidak berpengaruh nyata ($P>0,05$) terhadap rata-rata ukuran tubuh di akhir penelitian dan pertambahan ukuran tubuh ternak yang meliputi lingkar dada, panjang badan, dan tinggi pundak. Hasil ini memiliki fenomena yang sama dengan penelitian Purwadi (2017) bahwa pemberian konsentrat dengan kandungan protein yang berbeda, yaitu 10,23% dan 13,79% pada pedet betina lepas sapih usia 3,5 bulan memberikan pengaruh yang tidak nyata terhadap

pertambahan ukuran tubuh pedet FH betina lepas sapih.

Tabel 2. Rataan Ukuran Tubuh Pedet FH Betina Lepas Sapih

| Parameter | Perlakuan | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| | ----------(cm)---------- | | | |
| Awal | | | | |
| Lingkar Dada | 116,92±8,45 | 115,25 ±13,58 | 114,55 ±9,84 | 115,40 ±6,30 |
| Panjang Badan | 96,33 ±8,68 | 97,27 ±10,82 | 98,95 ±7,93 | 99,25 ±3,30 |
| Tinggi Pundak | 70,40 ±4,62 | 70,92 ±4,83 | 71,50 ±3,76 | 71,20 ±2,48 |
| Akhir | | | | |
| Lingkar Dada | 119,23 ±7,82 | 119,48 ±12,25 | 119,15 ±7,46 | 119,50 ±6,46 |
| Panjang Badan | 101,08 ±7,89 | 101,65 ±9,72 | 103,33 ±7,67 | 102,73 ±4,22 |
| Tinggi Pundak | 72,35 ±3,92 | 73,15 ±3,67 | 73,85 ±3,23 | 73,38 ±1,60 |
| Pertambahan Ukuran Tubuh (cm/bulan) | | | | |
| Lingkar Dada | 2,31 ±1,36 | 4,23 ±1,85 | 4,60 ±2,81 | 4,10 ±1,13 |
| Panjang Badan | 4,75 ±3,10 | 4,38 ±1,80 | 4,38 ±1,41 | 3,48 ±1,83 |
| Tinggi Pundak | 1,95 ±1,08 | 2,23 ±1,58 | 2,35 ±2,16 | 2,18 ±1,48 |

Pertambahan ukuran tubuh yang tidak berbeda antar perlakuan dapat disebabkan oleh jumlah konsumsi harian yang relatif sama sehingga nutrisi yang dicerna oleh pedet juga sama. Rataan konsumsi BK juga tidak berbeda nyata, yaitu P1 3,43 kg/hari, P2 3,54 kg/hari, P3 3,58 kg/hari dan P4 3,34 kg/hari. Substitusi *calf starter* ditujukan untuk membuat kandungan nutrisi pada pakan konsentrat untuk pedet lepas sapih di peternakan rakyat menjadi lebih baik jika dibandingkan dengan pakan dari konsentrat sapi laktasi saja. Pakan hijauan diberikan secara *adlibitum* terukur dengan tujuan pedet dapat memenuhi kekurangan nutrisi dari konsumsi konsentrat dengan cara mendapatkannya dari konsumsi hijauan. Namun pemberian

konsentrat yang 1% dari BB atau dengan imbangan H : K sebesar 70 : 30 ini maka diduga jika konsumsi BK relatif sama akan diikuti konsumsi nutrien lain yang relatif sama juga. Nutrien dari proses pencernaan pakan yang berupa energi, protein, lemak, mineral, dan sebagainya akan digunakan pedet untuk memenuhi kebutuhan nutrisi untuk pertumbuhan pedet. Imran *et al.* (2012) menyatakan bahwa nutrien yang dicerna oleh pedet akan digunakan untuk memenuhi kebutuhan dalam mendukung pertumbuhan pedet sesuai dengan genetiknya. Penelitian Kargar *et al.* (2019) juga menunjukkan ukuran tubuh pedet lepas sapih yang tidak berbeda karena jumlah konsumsi bahan kering dan kandungan nutrisi yang terkonsumsi relatif sama. Menurut Winarti dan Widyastuti (2016) jika konsumsi BK yang hampir sama akan menghasilkan pertumbuhan pedet antar perlakuan tidak memiliki perbedaan karena konsumsi zat gizinya hampir sama, baik dari konsumsi protein kasar, lemak kasar, serta serat kasar.

Pertumbuhan pedet lepas sapih ditunjukkan oleh pertambahan ukuran tubuhnya. Hasil penelitian ini menunjukkan bahwa pertambahan ukuran tubuh pedet lepas sapih antar perlakuan relatif sama. Hal ini diduga karena saat lepas sapih kondisi dan fungsi rumen sudah berkembang sempurna, sehingga hasil pencernaan pakan secara fermentatif dalam rumen yang dapat dimanfaatkan untuk pertumbuhan pedet lepas sapih pada setiap perlakuan relatif sama, sehingga menghasilkan ukuran tubuh yang relatif sama walaupun *calf starter* memiliki kualitas yang lebih baik dibanding konsentrat sapi perah laktasi. Hal tersebut dapat disebabkan oleh kondisi rumen pada pedet lepas sapih yang sudah siap untuk mencerna pakan padat. McCurdy *et al.* (2019) menyatakan bahwa ketika pedet sudah lepas sapih maka rumen pedet sudah siap untuk mencerna pakan padat dan rumen menjadi jauh lebih peka terhadap fermentabilitas makanan. Mikroba rumen diduga sudah mampu untuk memfermentasi konsentrat dan hijauan dengan baik, sehingga sudah tersedia protein mikroba yang cukup untuk pedet lepas sapih baik pada P1, P2, P3 maupun P4. Pramita *et al.* (2016) menyatakan bahwa mikroba rumen merupakan sumber protein utama bagi induk semang, selain itu

mikroba rumen berperan penting dalam mencerna pakan karena dapat menghasilkan enzim yang dapat mencerna serat pada pakan berkualitas rendah.

Rumen pedet lepas sapih memiliki mikroorganisme yang sudah cukup lengkap. Dengan kondisi rumen yang sudah siap, pedet lepas sapih mampu untuk memanfaatkan hijauan dan konsentrat dengan baik untuk memenuhi kebutuhan nutrisinya. Hal tersebut mengakibatkan pemberian konsentrat sapi laktasi dengan kandungan PK 16,40% dan TDN 64,91% (P4) sudah memberikan hasil pertambahan ukuran tubuh yang relatif sama dengan konsentrat yang disubstitusi *calf starter* (P1, P2, P3), jika diiringi dengan pemberian hijauan yang optimal.

**Pertambahan Lingkar Dada**

Pertambahan ukuran lingkar dada pedet yang diberi perlakuan substitusi *calf starter* pada konsentrat sapi laktasi (P1, P2, P3, dan P4) masing-masing yaitu 2,31 ±1,36 cm/bulan, 4,23 ±1,85 cm/bulan, 4,60 ±2,81 cm/bulan, dan 4,10 ±1,13 cm/bulan. Hasil tersebut lebih rendah dari hasil penelitian Manthey *et al.* (2016) dengan perlakuan penambahan DDGS pada konsentrat dengan konsentrasi yang berbeda pada pedet Holstein yaitu rata-rata 5,22 cm/bulan, juga hasil penelitian Wang *et al.* (2017) yang melakukan pemberian konsentrat dengan kandungan *physically effective neutral detergent fiber* (peNDF) yang berbeda pada pedet Holstein yaitu 5,36 cm/bulan. Hal tersebut sesuai pernyataan Ratnasari *et al.* (2019) bahwa perbedaan pertumbuhan pada ternak dapat disebabkan oleh iklim, kemampuan genetik masing-masing ternak, manajemen pemeliharan dan pakan.

Pemberian substitusi *calf starter* pada konsentrat sapi laktasi tidak berpengaruh terhadap pertambahan ukuran lingkar dada pedet FH betina lepas sapih ($P>0,05$). Kondisi tersebut mungkin terjadi karena nurtisi dari pakan yang dikonsumsi pedet telah digunakan untuk pertumbuhan tulang, pertumbuhan organ, dan pertumbuhan dagingnya. Hal tersebut sesuai dengan pendapat Parsons *et al.* (2020) yang menyatakan bahwa ukuran tubuh berkaitan

erat dengan bobot badan yang dipengaruhi oleh pertumbuhan tulang kemudian deposisi lemak. Pertumbuhan daging dan tulang mempengaruhi ukuran lingkar dada, lebar dada, lingkar perut dan bobot badan ternak, sedangkan pertumbuhan tulang berpengaruh terhadap panjang badan, tinggi badan, serta bobot badan ternak. Pertambahan ukuran lingkar dada terjadi karena lingkar dada berkaitan erat dengan bobot badan ternak, sehingga ketika bobot ternak naik maka lingkar dada akan semakin besar, termasuk pada pedet sapi FH (Sulistyowati *et al*., 2009; Hardiono *et al*., 2016; Rotondo *et al*., 2021). Syaiful *et al.* (2020) menyatakan bahwa semakin besar lingkar dada maka semakin besar pula organ-organ yang berada di dalam rongga dada seperti jantung dan paru-paru, oleh sebab itu lingkar dada dapat digunakan sebagai indikator kapasitas tubuh pedet.

**Pertambahan Panjang Badan**

Pemberian substitusi *calf starter* pada konsentrat sapi laktasi tidak berpengaruh terhadap pertambahan ukuran panjang badan pedet FH betina lepas sapih (P>0,05). Hasil dari masing-masing perlakuan yaitu 4,75 ±3,10 cm/bulan, 4,38 ±1,80 cm/bulan, 4,38 ±1,41 cm/bulan, dan 3,48 ±1,83 cm/bulan. Hasil tersebut lebih tinggi dari hasil penelitian Anderson *et al.* (2015) dengan perlakuan pemberian konsentrat dari biji-bijian dengan kandungan lemak dan protein yang berbeda pada pedet Holstein yaitu rata-rata 3,93 cm/bulan, namun lebih rendah dari hasil rata-rata penelitian Wang *et al.* (2017) dengan perlakuan konsentrat dengan kandungan *physically effective neutral detergent fiber* (peNDF) yang berbeda pada pedet Holstein yaitu 6,15 cm/bulan. Hasil penelitian tersebut berbeda karena disebabkan oleh beberapa faktor, yaitu umur ternak, genetik, kualitas pakan, dan manajemen pemeliharaan. Hal tersebut sesuai dengan pendapat Vavrisinova *et al.* (2019) yang menyatakan bahwa model pertumbuhan pada pedet dipengaruhi oleh umur, genetik, pemberian pakan dan manajemen yang berbeda.

Ukuran panjang tubuh pedet yang tidak berbeda, akibat dari perlakuan pemberian substitusi *calf starter* pada konsentrat sapi laktasi, dapat disebabkan oleh pengaruh genetik dan umur yang hampir sama. Hal tersebut sesuai dengan hasil penelitian Senevirathne *et al.* (2016) bahwa tidak adanya perbedaan antar perlakuan terhadap ukuran tubuh pedet menunjukkan bahwa pedet berada di periode yang sama sehingga tingkat pertumbuhan kerangka tubuhnya tidak berbeda. Pada saat penelitian dilaksanakan, pedet berada di fase percepatan pertumbuhan sehingga pakan yang dikonsumsi pedet akan digunakan maksimal untuk pertumbuhan kerangka tubuhnya. Putra dan Fajrina (2020) menyatakan bahwa laju pertumbuhan maksimal terjadi pada saat pedet berumur 4 – 8 bulan.

**Pertambahan Tinggi Pundak**

Pemberian substitusi *calf starter* pada konsentrat sapi laktasi tidak memiliki pengaruh yang berbeda terhadap pertambahan ukuran tinggi pundak pedet FH betina lepas sapih ($P>0,05$). Pemberian konsentrat perlakuan memberikan pertambahan ukuran tinggi pundak masing-masing sebanyak 1,95 ±1,08 cm/bulan pada P1; 2,23 ±1,58 cm/bulan pada P2; 2,35 ±2,16 cm/bulan pada P3 dan 2,18 ±1,48 cm/bulan pada P4. Hasil tersebut lebih rendah dari hasil penelitian Manthey dan Anderson (2018) dengan pemberian konsentrat berbasis jagung dan kedelai (dengan pemberian hijauan *ad libiutum*) pada pedet Holstein memiliki hasil rata-rata pertambahan tinggi gumba sebesar 3,03 cm/bulan. Perbedaan hasil penelitian ini dapat dipengaruhi oleh faktor umur ternak, iklim lingkungan, pakan yang diberikan, serta manajemen pemeliharaan. Hal tersebut sesuai pendapat Place dan Mitloehner (2010) bahwa iklim, umur, manajemen pakan dan manajemen pemeliharaan merupakan faktor-faktor yang berpengaruh terhadap pertumbuhan ternak.

Hasil pertambahan tinggi pundak yang tidak berbeda dari semua perlakuan pemberian substitusi *calf starter* pada konsentrat sapi laktasi juga dikarenakan oleh umur pedet yang

sedang dalam masa awal pertumbuhan sehingga nutrisi dari pakan yang dukonsumsi digunakan untuk pertumbuhan tulangnya. Hal tersebut sesuai dengan pendapat Syaiful *et al.* (2020) yang menyatakan bahwa bahwa pada umur 0 – 6 bulan pedet mengalami pertumbuhan yang lebih cepat pada kaki depannya karena kaki depan digunakan untuk aktif bergerak pada saat pedet menyusu pada induknya, selain itu kaki depan digunakan untuk menopang berat tubuh pedet. Pertambahan tinggi pundak berkaitan erat dengan pertumbuhan tulang kerangka tubuh pedet. Hal tersebut sesuai dengan pendapat Maluhima *et al.* (2019) yang menyatakan bahwa tinggi pundak dipengaruhi oleh beberapa faktor, diantaranya adalah karena manajemen pemberian pakan, genetik, kondisi ternak itu sendiri, serta mempunyai kaitan erat dengan ukuran kerangka pedet.

## KESIMPULAN

Substitusi *calf starter* pada pakan konsentrat sapi laktasi tidak memberikan pengaruh yang berbeda terhadap pertambahan ukuran tubuh (lingkar dada, panjang tubuh, tinggi pundak) pedet FH betina lepas sapih. Pemberian pakan konsentrat sapi laktasi dengan PK 16,40% dan TDN 64,91% serta diikuti hijauan yang berkualitas baik dalam jumlah cukup, sudah mampu mencukupi kebutuhan nutrien pada pedet lepas sapih.

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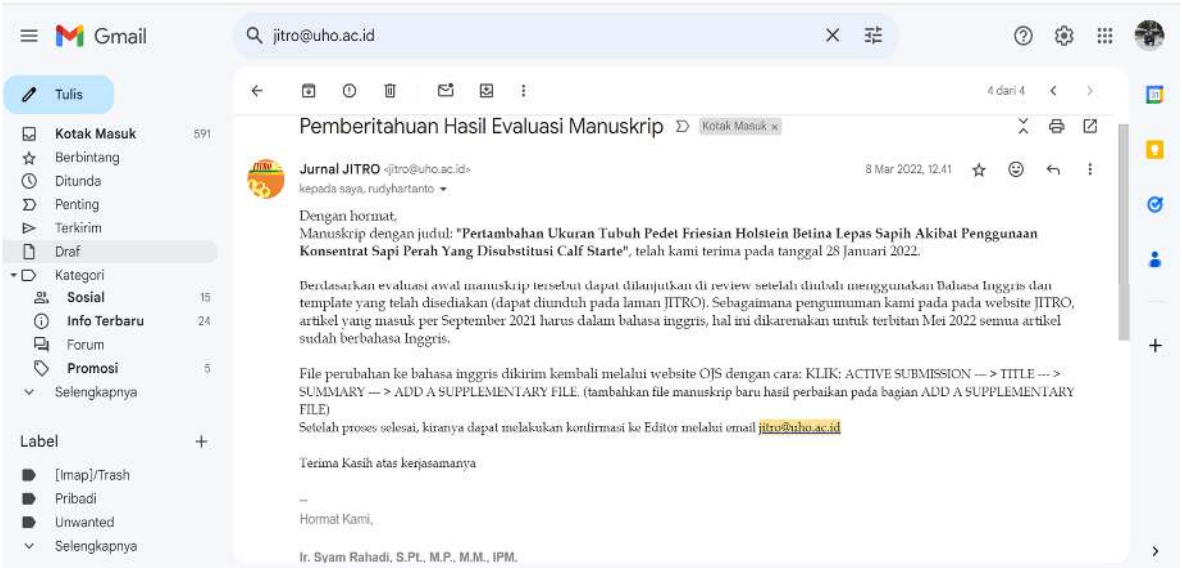
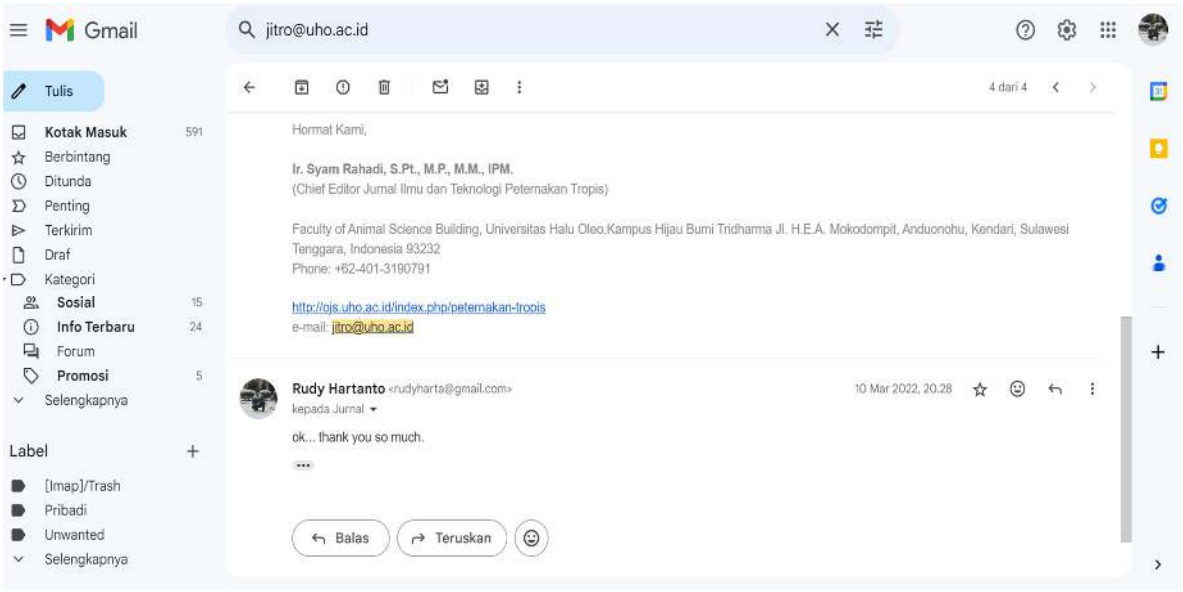
**Korespondensi selanjutnya Via Email**

Review Ke-1 : Permintaan Merubah dari Bahasa Indonesia ke Bahasa Inggris



# Pertambahan Ukuran Tubuh Pedet *Friesian Holstein* Betina Lepas Sapih Akibat Penggunaan Konsentrat Sapi Perah Yang Disubstitusi *Calf Starter*

Commented [U1]: Rubah dalam bahasa inggris dan perbaiki sesuai saran

## *Increase in Body Measurements of Post-Weaning Female Holstein Friesian Calves Due to the Use of Concentrated Dairy Cows Substituted by Calf Starter*

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Departemen Peternakan, Fakultas Peternakan dan Pertanian, Universitas Diponegoro
Kampus drh. Soejono Koesoemowardojo, Tembalang, Semarang 50275

*Email korespondensi: rudyharta@gmail.com; rudyhartanto@lecturer.undip.ac.id

## ABSTRAK

Penelitian bertujuan untuk menganalisis pertambahan ukuran tubuh pedet *Friesian Holstein* (FH) betina lepas sapih yang diberi konsentrat sapi perah dengan substitusi *calf starter* yang berbeda level. Materi adalah 4 ekor pedet FH betina lepas sapih umur 4 – 5 bulan, BB rata-rata 101,38 ± 14,21 kg. Pakan berupa rumput gajah, *calf starter* serta konsentrat sapi laktasi. Penelitian menggunakan rancangan bujur sangkar latin (RBSL), dengan 4 perlakuan konsentrat yaitu P1 (75% *calf starter* dan 25% konsentrat sapi laktasi), P2 (50% *calf starter* dan 50% konsentrat sapi laktasi), P3 (25% *calf starter* dan 75% konsentrat sapi laktasi), P4 (100% konsentrat sapi laktasi); dan 4 ulangan dalam 4 periode (setiap periode berlangsung 1 bulan). Konsentrat diberikan 1% BB dalam bahan kering; rumput gajah serta air minum diberikan secara *adlibitum* terukur. Parameter penelitian adalah pertambahan ukuran tubuh (lingkar dada (LD), panjang badan (PB), tinggi pundak (TP)). Data dianalisis menggunakan Anova. Hasil menunjukkan perlakuan tidak berpengaruh nyata (P>0,05) terhadap pertambahan ukuran tubuh pedet FH betina lepas sapih. Pertambahan ukuran tubuh pada P1 (LD = 2,30 cm/bulan, PB = 4,75 cm/bulan, TP = 1,95 cm/bulan), P2 (LD = 4,20 cm/bulan, PB = 4,38 cm/bulan, TP = 2,23 cm/bulan), P3 (LD = 4,60 cm/bulan, PB = 4,38 cm/bulan, TP = 2,35 cm/bulan), P4 (LD = 4,10 cm/bulan, PB = 3,48 cm/bulan, TP = 2,18 cm/bulan). Disimpulkan bahwa dengan pakan hijauan berkualitas dalam jumlah cukup, pemberian 100% konsentrat sapi laktasi pada pedet FH betina lepas sapih dapat menghasilkan pertambahan ukuran tubuh yang relatif sama dengan pemberian substitusi calf starter (25-75%) pada konsentrat sapi perah sebagai pakan konsentratnya.

Commented [U2]: Tujuan penelitian di abstrak dan pendahuluan harus sama

**Kata Kunci** : pedet FH betina lepas sapih, ukuran tubuh, calf starter, konsentrat

## ABSTRACT

The aim of the study was to analyze the increase in body measurements of post-weaning female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass,

calf starter and lactating cow concentrate. The study used a Latin square design (RBSL), with 4 concentrate treatments, namely P1 (75% calf starter and 25% lactating cow concentrate), P2 (50% calf starter and 50% lactating cow concentrate), P3 (25% calf starter and 75% lactating cow concentrate), P4 (100% lactating cow concentrate); and 4 replications in 4 periods (each period in 1 month). Concentrate is given 1% BW in dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body measurements (heart girth (HG), body length (BL) and shoulder height (SH)). Data were analyzed using ANOVA. The results showed that the treatment had no significant effect (P>0.05) on the increase in body size of post-weaning female HF calves. Increase in body measurements at P1 (HG = 2.30 cm/month, BL = 4.75 cm/month, SH = 1.95 cm/month), P2 (HG = 4.20 cm/month, BL = 4.38 cm/month, SH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, SH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, SH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% lactating cow concentrate to post-weaning female HF calves could result in an increase in body measurements that was relatively the same as the substitution of calf starter (25-75%) in lactating cow concentrate as concentrate feed.

**Keywords:** post-weaning female HF calves, body measurements, calf starter, concentrate

## PENDAHULUAN

Pemberian pakan dan minum serta kesehatan pedet merupakan faktor penting yang perlu diperhatikan guna mendapatkan pertumbuhan pedet yang baik, dimasa pra sapih maupun lepas sapih. Pedet yang sudah lepas sapih tidak mendapatkan susu dari induknya dan memenuhi kebutuhan nutrisinya secara penuh dari hijauan dan konsentrat (Kusumawati *et al*., 2018; Atabany *et al.*, 2020). Pedet mulai dapat disapih saat berumur 8 minggu, yaitu setelah mampu mengkonsumsi pakan starter 0,5 – 0,68 kg /hari, tetapi penyapihan di umur ini memiliki resiko kematian pedet yang tinggi sehingga pedet pada umunya disapih saat umur 3 bulan (NRC, 2001; Prihantoro *et al.,* 2012). Saat lepas sapih, pedet memasuki fase awal pertumbuhan, sehingga sebagian besar nutrisi yang dikonsumsi akan digunakan untuk pertumbuhan seperti pembesaran kerangka tubuhnya (Imran *et al*, 2012; Welboren *et al*., 2018).

Commented [U3]: perjelas dengan fungsi lainnya juga

Pembentukan ukuran tubuh pedet betina saat lepas sapih sangat perlu diperhatikan karena pedet betina yang dari awal sudah mempunyai ukuran tubuh ideal, akan menjadi

indukan yang ideal pula. Selain pertambahan bobot badan, pertambahan ukuran tubuh (lingkar dada, tinggi pundak, panjang tubuh) pada pedet lepas sapih juga merupakan ukuran tampilan atau performens pedet (Hardiono *et al*., 2016; Rotondo *et al*., 2021). Pedet saat lepas sapih sebaiknya memiliki ukuran lingkar dada 96 cm dan tinggi badan 75 cm, supaya nantinya dapat memenuhi target lingkar dada 155 cm dan tinggi badan 115 cm pada saat masuk usia 15 bulan untuk IB pertama kali (Alim dan Hidaka, 2002). Pembentukan ukuran tubuh ini dipengaruhi oleh kecukupan akan kebutuhan nutriennya. Pedet lepas sapih biasanya diberi pakan hijauan berkualitas tinggi dan konsentrat yang diformulasikan untuk memenuhi kebutuhan nutrisi serta meningkatkan bobot badannya (American Society of Animal Science, 2020).

Namun pada praktik di lapangan, pemberian pakan untuk pedet lepas sapih belum diperhatikan dengan baik oleh para peternak kecil. Umumnya peternakan rakyat memberikan konsentrat sapi laktasi pada pedet dengan pertimbangan harga konsentrat yang lebih murah. Konsentrat sapi laktasi minimal memiliki kandungan PK sebesar 14% dan TDN 68%, sedangkan pada *calf starter* kadungan PK 16-21% dan TDN 70-80% (BSN, 2017). Padahal kebutuhan nutrisi pedet mulai dari lepas sapih hingga dara berbeda dengan kebutuhan sapi dewasa, sehingga pedet perlu diberikan pakan yang berbeda pula dengan sapi dewasa.

Substitusi *calf starter* pada konsentrat sapi laktasi dilakukan dengan tujuan untuk meningkatkan kualitas nutrien pada pakan konsentrat yang diberikan pada pedet lepas sapih. *Calf starter* berbeda dengan konsentrat sapi laktasi baik secara fisik maupun kualitasnya (Mukodiningsih *et al.*, 2012). Pedet lepas sapih yang mendapatkan pakan yang lebih berkualitas akan menghasilkan performen dalam ukuran tubuh yang lebih baik juga. Bobot badan dan ukuran tubuh yang lebih besar pada umur yang sama menunjukkan adanya pertumbuhan yang lebih baik (Turiello *et al*., 2016; Nemati *et al*., 2016).

Penelitian ini bertujuan untuk mengetahui dan mengkaji tentang pertambahan ukuran tubuh pedet FH betina lepas sapih yang diberi konsentrat sapi perah dengan substitusi *calf starter* yang berbeda level.

Commented [U4]: samakan dengan yang di abstrak

## MATERI DAN METODE

### Materi

Materi yang digunakan yaitu 4 ekor pedet FH betina lepas sapih umur 4 – 5 bulan dengan BB rata-rata 101,38 ± 14,21 kg. Pedet dipelihara dalam kandang metabolik selama penelitian berlangsung. Pita ukur merek 300 cm dengan keakuratan 0,1 cm dan tongkat ukur dari *stainless steel* 1,5 m dengan kepekaan 0,1 cm untuk mengukur dimensi tubuh ternak. Pakan yang digunakan yaitu rumput gajah, konsentrat sapi laktasi (KSL), dan *calf starter* (CS) produksi Teaching Farm FPP Undip.

### Metode

Pakan yang diberikan berupa hijauan dan konsentrat perlakuan yang disesuaikan dengan kebutuhan BK ternak. Konsentrat perlakuan (dalam BK) diberikan sebanyak 1% BB dalam dua kali pemberian, yaitu pagi pukul 06.00 dan sore pukul 15.00. Hijauan dan air minum diberikan secara *ad libitum* terukur. Konsentrat perlakuan terdiri atas P1 (75% CS dan 25% KSL), P2 (50% CS dan 50% KSL), P3 ( 25% CS dan 75% KSL), dan P4 (100% KSL). Kandungan nutrisi pakan yang diberikan terlihat pada tabel 1. Rancangan penelitian yang digunakan yaitu rancangan bujur sangkar latin (RBSL) dengan 4 perlakuan dan 4 periode.

Commented [U5]: Apakah ada pengaturan / jeda waktu dalam pemberian hijauan dan konsentrat?

Pemberian dan sisa dari pakan serta air minum pada ternak dicatat di buku catatan secara rutin. Penelitian dilakukan dalam 4 periode, setiap periode dilakukan selama 30 hari pengamatan. Parameter yang diukur yaitu lingkar dada (LD), panjang badan (PB), tinggi

pundak (TP). Pengukuran ukuran tubuh dilakukan pada awal dan akhir periode, dilanjutkan istirahat selama 5 hari, dan dilanjutkan ke periode berikutnya.

Commented [U6]: Apakah 5 hari ini sudah cukup dalam menghilangan efek perlakuan sebelumnya? Harus ada pustaka pendukungnya.!

Tabel 1. Kandungan Nutrien Pakan

| | Air | Abu | TDN | PK | LK | SK | Ca | P |
|---|---|---|---|---|---|---|---|---|
| | ---------- % ---------- | | | | | | | |
| Konsentrat Sapi Laktasi | 9,42 | 9,90 | 64,91 | 16,40 | 6,42 | 26,87 | 0,51 | 0,56 |
| *Calf starter* | 11,17 | 12,32 | 76,13 | 19,70 | 5,25 | 8,74 | 0,08 | 0,50 |
| Rumput Gajah | 7,73 | 13,31 | 58,5 | 12,13 | 2,17 | 28,64 | 0,30 | 0,27 |
| Konsentrat P1 | 10,73 | 11,71 | 73,32 | 18,87 | 5,54 | 13,27 | 0,18 | 0,51 |
| Konsentrat P2 | 10,29 | 11,11 | 70,52 | 18,05 | 5,83 | 17,80 | 0,29 | 0,53 |
| Konsentrat P3 | 9,86 | 10,50 | 67,71 | 17,25 | 6,13 | 22,33 | 0,40 | 0,54 |
| Konsentrat P4 | 9,42 | 9,90 | 64,91 | 16,40 | 6,42 | 26,87 | 0,51 | 0,56 |

**Analisis Data**

Semua data dianalisis menggunakan analisis ragam (ANOVA). Jika terdapat pengaruh perlakuan maka dilanjutkan uji Duncan.

Commented [U7]: Jelaskan fungsi uji duncan!

## HASIL DAN PEMBAHASAN

Hasil penelitian pengaruh pemberian substitusi *calf starter* pada konsentrat sapi laktasi terhadap pertambahan ukuran tubuh pedet FH betina lepas sapih disajikan pada Tabel 2. Perlakuan substitusi *calf starter* pada konsentrat sapi laktasi (P1, P2, P3, dan P4) tidak berpengaruh nyata (P>0,05) terhadap rata-rata ukuran tubuh di akhir penelitian dan pertambahan ukuran tubuh ternak yang meliputi lingkar dada, panjang badan, dan tinggi pundak. Hasil ini memiliki fenomena yang sama dengan penelitian Purwadi (2017) bahwa pemberian konsentrat dengan kandungan protein yang berbeda, yaitu 10,23% dan 13,79% pada pedet betina lepas sapih usia 3,5 bulan memberikan pengaruh yang tidak nyata terhadap

pertambahan ukuran tubuh pedet FH betina lepas sapih.

Tabel 2. Rataan Ukuran Tubuh Pedet FH Betina Lepas Sapih

| Parameter | Perlakuan | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| | ----------(cm)---------- | | | |
| Awal | | | | |
| Lingkar Dada | 116,92±8,45 | 115,25 ±13,58 | 114,55 ±9,84 | 115,40 ±6,30 |
| Panjang Badan | 96,33 ±8,68 | 97,27 ±10,82 | 98,95 ±7,93 | 99,25 ±3,30 |
| Tinggi Pundak | 70,40 ±4,62 | 70,92 ±4,83 | 71,50 ±3,76 | 71,20 ±2,48 |
| Akhir | | | | |
| Lingkar Dada | 119,23 ±7,82 | 119,48 ±12,25 | 119,15 ±7,46 | 119,50 ±6,46 |
| Panjang Badan | 101,08 ±7,89 | 101,65 ±9,72 | 103,33 ±7,67 | 102,73 ±4,22 |
| Tinggi Pundak | 72,35 ±3,92 | 73,15 ±3,67 | 73,85 ±3,23 | 73,38 ±1,60 |
| Pertambahan Ukuran Tubuh (cm/bulan) | | | | |
| Lingkar Dada | 2,31 ±1,36 | 4,23 ±1,85 | 4,60 ±2,81 | 4,10 ±1,13 |
| Panjang Badan | 4,75 ±3,10 | 4,38 ±1,80 | 4,38 ±1,41 | 3,48 ±1,83 |
| Tinggi Pundak | 1,95 ±1,08 | 2,23 ±1,58 | 2,35 ±2,16 | 2,18 ±1,48 |

Pertambahan ukuran tubuh yang tidak berbeda antar perlakuan dapat disebabkan oleh jumlah konsumsi harian yang relatif sama sehingga nutrisi yang dicerna oleh pedet juga sama. Rataan konsumsi BK juga tidak berbeda nyata, yaitu P1 3,43 kg/hari, P2 3,54 kg/hari, P3 3,58 kg/hari dan P4 3,34 kg/hari. Substitusi *calf starter* ditujukan untuk membuat kandungan nutrisi pada pakan konsentrat untuk pedet lepas sapih di peternakan rakyat menjadi lebih baik jika dibandingkan dengan pakan dari konsentrat sapi laktasi saja. Pakan hijauan diberikan secara *adlibitum* terukur dengan tujuan pedet dapat memenuhi kekurangan nutrisi dari konsumsi konsentrat dengan cara mendapatkannya dari konsumsi hijauan. Namun pemberian

konsentrat yang 1% dari BB atau dengan imbangan H : K sebesar 70 : 30 ini maka diduga jika konsumsi BK relatif sama akan diikuti konsumsi nutrien lain yang relatif sama juga. Nutrien dari proses pencernaan pakan yang berupa energi, protein, lemak, mineral, dan sebagainya akan digunakan pedet untuk memenuhi kebutuhan nutrisi untuk pertumbuhan pedet. Imran *et al.* (2012) menyatakan bahwa nutrien yang dicerna oleh pedet akan digunakan untuk memenuhi kebutuhan dalam mendukung pertumbuhan pedet sesuai dengan genetiknya. Penelitian Kargar *et al.* (2019) juga menunjukkan ukuran tubuh pedet lepas sapih yang tidak berbeda karena jumlah konsumsi bahan kering dan kandungan nutrisi yang terkonsumsi relatif sama. Menurut Winarti dan Widyastuti (2016) jika konsumsi BK yang hampir sama akan menghasilkan pertumbuhan pedet antar perlakuan tidak memiliki perbedaan karena konsumsi zat gizinya hampir sama, baik dari konsumsi protein kasar, lemak kasar, serta serat kasar.

Pertumbuhan pedet lepas sapih ditunjukkan oleh pertambahan ukuran tubuhnya. Hasil penelitian ini menunjukkan bahwa pertambahan ukuran tubuh pedet lepas sapih antar perlakuan relatif sama. Hal ini diduga karena saat lepas sapih kondisi dan fungsi rumen sudah berkembang sempurna, sehingga hasil pencernaan pakan secara fermentatif dalam rumen yang dapat dimanfaatkan untuk pertumbuhan pedet lepas sapih pada setiap perlakuan relatif sama, sehingga menghasilkan ukuran tubuh yang relatif sama walaupun *calf starter* memiliki kualitas yang lebih baik dibanding konsentrat sapi perah laktasi. Hal tersebut dapat disebabkan oleh kondisi rumen pada pedet lepas sapih yang sudah siap untuk mencerna pakan padat. McCurdy *et al.* (2019) menyatakan bahwa ketika pedet sudah lepas sapih maka rumen pedet sudah siap untuk mencerna pakan padat dan rumen menjadi jauh lebih peka terhadap fermentabilitas makanan. Mikroba rumen diduga sudah mampu untuk memfermentasi konsentrat dan hijauan dengan baik, sehingga sudah tersedia protein mikroba yang cukup untuk pedet lepas sapih baik pada P1, P2, P3 maupun P4. Pramita *et al.* (2016) menyatakan bahwa mikroba rumen merupakan sumber protein utama bagi induk semang, selain itu

**Commented [U8]:** Ukuran tubuh pedet diengaruhi apa saja? Diperjelas!

mikroba rumen berperan penting dalam mencerna pakan karena dapat menghasilkan enzim yang dapat mencerna serat pada pakan berkualitas rendah.

Rumen pedet lepas sapih memiliki mikroorganisme yang sudah cukup lengkap. Dengan kondisi rumen yang sudah siap, pedet lepas sapih mampu untuk memanfaatkan hijauan dan konsentrat dengan baik untuk memenuhi kebutuhan nutrisinya. Hal tersebut mengakibatkan pemberian konsentrat sapi laktasi dengan kandungan PK 16,40% dan TDN 64,91% (P4) sudah memberikan hasil pertambahan ukuran tubuh yang relatif sama dengan konsentrat yang disubstitusi *calf starter* (P1, P2, P3), jika diiringi dengan pemberian hijauan yang optimal.

**Commented [U9]:** Diperjelas, apa saja mikroorganismenya!

**Pertambahan Lingkar Dada**

Pertambahan ukuran lingkar dada pedet yang diberi perlakuan substitusi *calf starter* pada konsentrat sapi laktasi (P1, P2, P3, dan P4) masing-masing yaitu 2,31 ±1,36 cm/bulan, 4,23 ±1,85 cm/bulan, 4,60 ±2,81 cm/bulan, dan 4,10 ±1,13 cm/bulan. Hasil tersebut lebih rendah dari hasil penelitian Manthey *et al.* (2016) dengan perlakuan penambahan DDGS pada konsentrat dengan konsentrasi yang berbeda pada pedet Holstein yaitu rata-rata 5,22 cm/bulan, juga hasil penelitian Wang *et al.* (2017) yang melakukan pemberian konsentrat dengan kandungan *physically effective neutral detergent fiber* (peNDF) yang berbeda pada pedet Holstein yaitu 5,36 cm/bulan. Hal tersebut sesuai pernyataan Ratnasari *et al.* (2019) bahwa perbedaan pertumbuhan pada ternak dapat disebabkan oleh iklim, kemampuan genetik masing-masing ternak, manajemen pemeliharan dan pakan.

**Commented [U10]:** perbedaan hasil ini dikarenakan faktor apa?

Pemberian substitusi *calf starter* pada konsentrat sapi laktasi tidak berpengaruh terhadap pertambahan ukuran lingkar dada pedet FH betina lepas sapih (P>0,05). Kondisi tersebut mungkin terjadi karena nurtisi dari pakan yang dikonsumsi pedet telah digunakan untuk pertumbuhan tulang, pertumbuhan organ, dan pertumbuhan dagingnya. Hal tersebut sesuai dengan pendapat Parsons *et al.* (2020) yang menyatakan bahwa ukuran tubuh berkaitan

erat dengan bobot badan yang dipengaruhi oleh pertumbuhan tulang kemudian deposisi lemak. Pertumbuhan daging dan tulang mempengaruhi ukuran lingkar dada, lebar dada, lingkar perut dan bobot badan ternak, sedangkan pertumbuhan tulang berpengaruh terhadap panjang badan, tinggi badan, serta bobot badan ternak. Pertambahan ukuran lingkar dada terjadi karena lingkar dada berkaitan erat dengan bobot badan ternak, sehingga ketika bobot ternak naik maka lingkar dada akan semakin besar, termasuk pada pedet sapi FH (Sulistyowati *et al*., 2009; Hardiono *et al*., 2016; Rotondo *et al*., 2021). Syaiful *et al.* (2020) menyatakan bahwa semakin besar lingkar dada maka semakin besar pula organ-organ yang berada di dalam rongga dada seperti jantung dan paru-paru, oleh sebab itu lingkar dada dapat digunakan sebagai indikator kapasitas tubuh pedet.

**Pertambahan Panjang Badan**

Pemberian substitusi *calf starter* pada konsentrat sapi laktasi tidak berpengaruh terhadap pertambahan ukuran panjang badan pedet FH betina lepas sapih (P>0,05). Hasil dari masing-masing perlakuan yaitu 4,75 ±3,10 cm/bulan, 4,38 ±1,80 cm/bulan, 4,38 ±1,41 cm/bulan, dan 3,48 ±1,83 cm/bulan. Hasil tersebut lebih tinggi dari hasil penelitian Anderson *et al.* (2015) dengan perlakuan pemberian konsentrat dari biji-bijian dengan kandungan lemak dan protein yang berbeda pada pedet Holstein yaitu rata-rata 3,93 cm/bulan, namun lebih rendah dari hasil rata-rata penelitian Wang *et al.* (2017) dengan perlakuan konsentrat dengan kandungan *physically effective neutral detergent fiber* (peNDF) yang berbeda pada pedet Holstein yaitu 6,15 cm/bulan. Hasil penelitian tersebut berbeda karena disebabkan oleh beberapa faktor, yaitu umur ternak, genetik, kualitas pakan, dan manajemen pemeliharaan. Hal tersebut sesuai dengan pendapat Vavrisinova *et al.* (2019) yang menyatakan bahwa model pertumbuhan pada pedet dipengaruhi oleh umur, genetik, pemberian pakan dan manajemen yang berbeda.

Ukuran panjang tubuh pedet yang tidak berbeda, akibat dari perlakuan pemberian substitusi *calf starter* pada konsentrat sapi laktasi, dapat disebabkan oleh pengaruh genetik dan umur yang hampir sama. Hal tersebut sesuai dengan hasil penelitian Senevirathne *et al.* (2016) bahwa tidak adanya perbedaan antar perlakuan terhadap ukuran tubuh pedet menunjukkan bahwa pedet berada di periode yang sama sehingga tingkat pertumbuhan kerangka tubuhnya tidak berbeda. Pada saat penelitian dilaksanakan, pedet berada di fase percepatan pertumbuhan sehingga pakan yang dikonsumsi pedet akan digunakan maksimal untuk pertumbuhan kerangka tubuhnya. Putra dan Fajrina (2020) menyatakan bahwa laju pertumbuhan maksimal terjadi pada saat pedet berumur 4 – 8 bulan.

**Commented [U11]:** bagaimana kaitan pertumbuhan pedet dengan pakan yang diberikan?

**Pertambahan Tinggi Pundak**

Pemberian substitusi *calf starter* pada konsentrat sapi laktasi tidak memiliki pengaruh yang berbeda terhadap pertambahan ukuran tinggi pundak pedet FH betina lepas sapih (P>0,05). Pemberian konsentrat perlakuan memberikan pertambahan ukuran tinggi pundak masing-masing sebanyak 1,95 ±1,08 cm/bulan pada P1; 2,23 ±1,58 cm/bulan pada P2; 2,35 ±2,16 cm/bulan pada P3 dan 2,18 ±1,48 cm/bulan pada P4. Hasil tersebut lebih rendah dari hasil penelitian Manthey dan Anderson (2018) dengan pemberian konsentrat berbasis jagung dan kedelai (dengan pemberian hijauan *ad libiutum*) pada pedet Holstein memiliki hasil rata-rata pertambahan tinggi gumba sebesar 3,03 cm/bulan. Perbedaan hasil penelitian ini dapat dipengaruhi oleh faktor umur ternak, iklim lingkungan, pakan yang diberikan, serta manajemen pemeliharaan. Hal tersebut sesuai pendapat Place dan Mitloehner (2010) bahwa iklim, umur, manajemen pakan dan manajemen pemeliharaan merupakan faktor-faktor yang berpengaruh terhadap pertumbuhan ternak.

Hasil pertambahan tinggi pundak yang tidak berbeda dari semua perlakuan pemberian substitusi *calf starter* pada konsentrat sapi laktasi juga dikarenakan oleh umur pedet yang

sedang dalam masa awal pertumbuhan sehingga nutrisi dari pakan yang dukonsumsi digunakan untuk pertumbuhan tulangnya. Hal tersebut sesuai dengan pendapat Syaiful *et al.* (2020) yang menyatakan bahwa bahwa pada umur 0 – 6 bulan pedet mengalami pertumbuhan yang lebih cepat pada kaki depannya karena kaki depan digunakan untuk aktif bergerak pada saat pedet menyusu pada induknya, selain itu kaki depan digunakan untuk menopang berat tubuh pedet. Pertambahan tinggi pundak berkaitan erat dengan pertumbuhan tulang kerangka tubuh pedet. Hal tersebut sesuai dengan pendapat Maluhima *et al.* (2019) yang menyatakan bahwa tinggi pundak dipengaruhi oleh beberapa faktor, diantaranya adalah karena manajemen pemberian pakan, genetik, kondisi ternak itu sendiri, serta mempunyai kaitan erat dengan ukuran kerangka pedet.

**Commented [U12]:** Dierjelas kaitannya tinggi pundak dengan pertumbuhan tulang kaki depan!

## KESIMPULAN

Substitusi *calf starter* pada pakan konsentrat sapi laktasi tidak memberikan pengaruh yang berbeda terhadap pertambahan ukuran tubuh (lingkar dada, panjang tubuh, tinggi pundak) pedet FH betina lepas sapih. Pemberian pakan konsentrat sapi laktasi dengan PK 16,40% dan TDN 64,91% serta diikuti hijauan yang berkualitas baik dalam jumlah cukup, sudah mampu mencukupi kebutuhan nutrien pada pedet lepas sapih.

**Commented [U13]:** Dilihat dari apa kecukupan tersebut!

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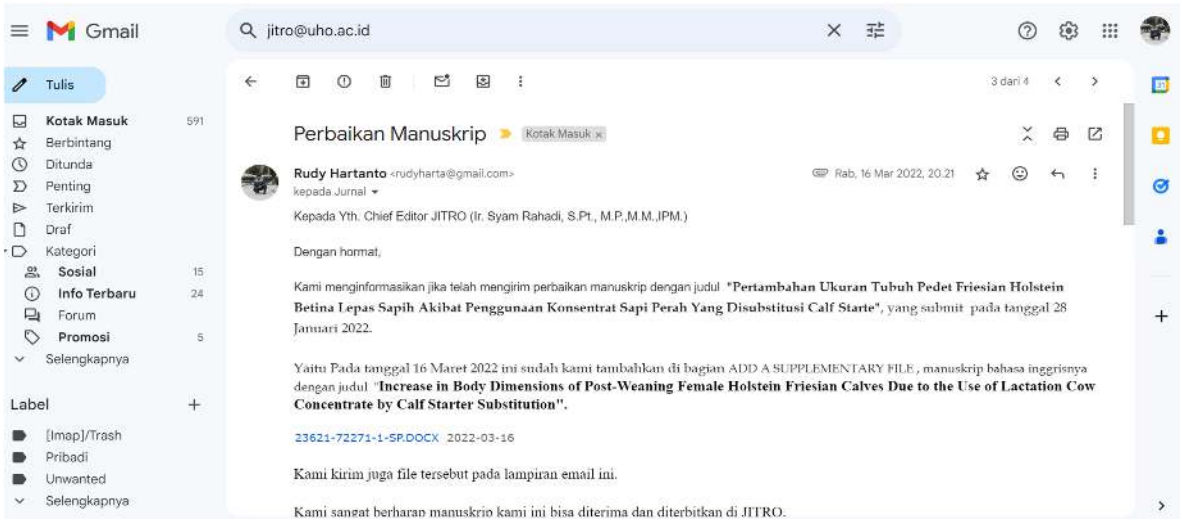

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Kami menginformasikan jika telah mengirim perbaikan manuskrip dengan judul **"Pertambahan Ukuran Tubuh Pedet Friesian Holstein Betina Lepas Sapih Akibat Penggunaan Konsentrat Sapi Perah Yang Disubstitusi Calf Starte"**, yang submit pada tanggal 28 Januari 2022.

Yaitu Pada tanggal 16 Maret 2022 ini sudah kami tambahkan di bagian ADD A SUPPLEMENTARY FILE , manuskrip bahasa inggrisnya dengan judul **"Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution".**

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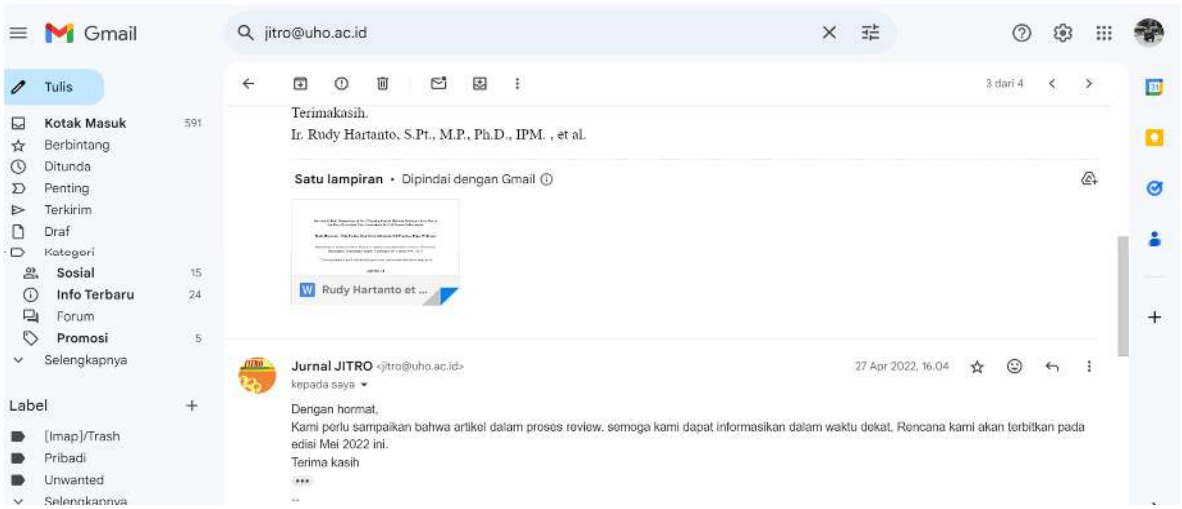

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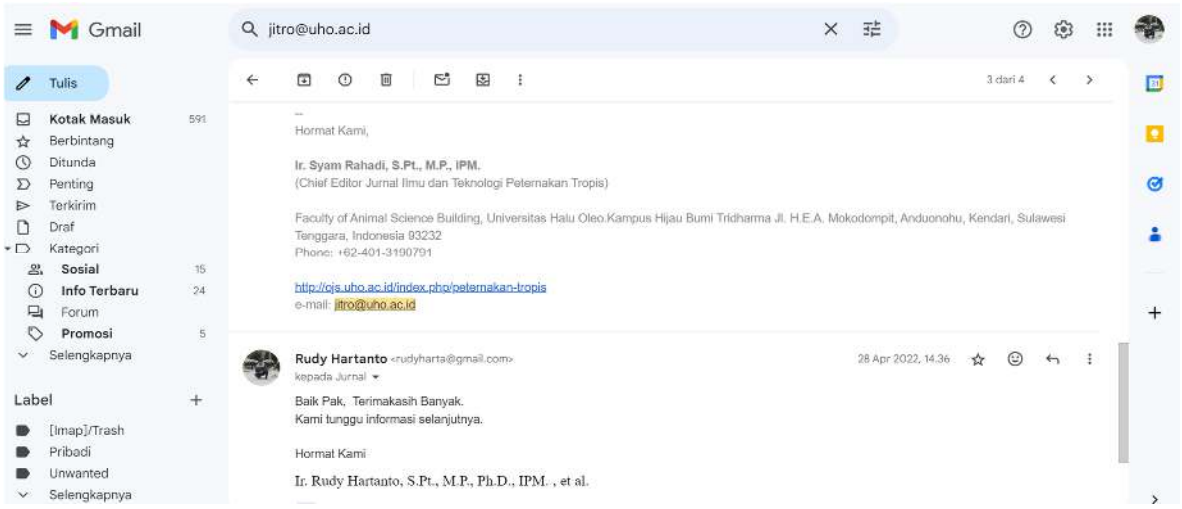

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Phone: +62-401-3190791

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# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Tembalang Campus, Semarang City, Central Java, 50275

* Corresponding E-mail: rudyharta@gmail.com; rudyhartanto@lecturer.undip.ac.id

## ABSTRACT

The aim of the study was to analyze the increase in body dimensions of post-weaning female Holstein Friesian (HF) calves fed with lactation cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass, calf starter (CS) and lactation cow concentrate (LCC). The study used a Latin square design, with 4 concentrate treatments, i.e. P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), P4 (100% LCC); and 4 replications in 4 periods (each period in 1 month). Concentrate was given 1% BW in dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body dimensions (heart girth (HG), body length (BL) and withers height (WH)). The treatments had no significant effect (P>0.05) on the increase in body dimensions, were P1 (HG = 2.31 cm/month, BL = 4.75 cm/month, WH = 1.95 cm/month), P2 (HG = 4.23 cm/month, BL = 4.38 cm/month, WH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, WH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, WH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% LCC to post-weaning female HF calves could result in an increase in body dimensions that was relatively the same as the substitution of CS (25-75%) in LCC as concentrate feed.

**Keywords:** post-weaning female HF calves, body dimensions, calf starter, lactation cow concentrate

## INTRODUCTION

Feeding and drinking as well as calf health are important factors that need to be considered in order to get good calf growth, both pre-weaning and after-weaning. Calves that have been weaned do not get milk and fulfill their nutritional needs in full from forages and concentrates (Kusumawati *et al*., 2018; Atabany *et al*., 2020). Calves can be weaned when

they are 8 weeks old, i.e. after they are able to consume calf starter 0.5 – 0.68 kg/day, but at this age weaning has a high risk of calf death so that calves are generally weaned at 3 months of age (NRC, 2001; Prihantoro *et al*., 2012). When weaning, the calf enters the initial phase of growth, so most of the nutrients consumed will be used for growth such as enlargement of the body skeleton (Imran *et al.*, 2012; Welboren *et al*., 2019).

The body dimensions of the female calf when weaning is very important because the female calf which from the start already has the ideal body dimensions, will also be an ideal breeder. In addition to body weight gain, the increase in body dimensions (heart girt, withers height, body length) in weaning calves is also a measure of the calf's appearance or performance (Hardiono *et al*., 2016; Rotondo *et al*., 2021). The calf when post-weaning should have heart girt of 96 cm and withers height of 75 cm, so that later it can meet the target of a heart girt of 155 cm and withers height of 115 cm at the time of entering the age of 15 months for first mating (Alim and Hidaka, 2002). The formation of body dimensions is influenced by the adequacy of nutrient needs. Weaning calves are usually fed high-quality forage and concentrates formulated to meet nutritional needs and increase body weight (American Society of Animal Science, 2020).

However, in practice in the field, the provision of feed for post-weaning female calves has not been well considered by small farmers. Generally, smallholder farms provide lactation cow concentrates to calves with the consideration of cheaper concentrate prices. At least lactation cow concentrate has crude protein CP content is 16-21% and TDN 70-80% (BSN, 2017). Whereas the nutritional needs of female calves from post-weaning to heifers are different from those of adult cattle, so calves need to be given different feeds from adult cows.

The substitution of calf starter in lactation cow concentrate was carried out with the aim of improving the nutritional quality of the concentrate feed given to weaning calves. Calf starter is different from lactation cow concentrate both physically and in quality

(Mukodiningsih *et al*., 2012). Post-Weaning calves that receive higher quality feed will produce better performance in body dimensions as well. Larger body weight and body dimensions at the same age indicate better growth (Turiello *et al*., 2016; Nemati *et al*., 2016).

This study aimed to analyze the increase in body dimensions of post-weaned female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of substitution of calf starter.

## MATERIALS AND METHODS

### Materials

The materials used were 4 post-weaning female Holstein Friesian (HF) calves aged 4-5 months with an average weight of 101.38 ± 14.21 kg. The calves were kept in metabolic cages for the duration of the study. 300 cm long measuring tape with 0.1 cm accuracy and 1.5 m stainless steel measuring stick with 0.1 cm accuracy were used to measure the body dimensions of livestock. The feed used were elephant grass (*Pennisetum purpureum*), lactation cow concentrate (LCC) and calf starter (CS) produced by Teaching Farm FPP Undip.

### Methods

The feed provided were forage and concentrate treatment which was adjusted to the dry matter (DM) needs of the calves. Treatment concentrate (in DM) was given as much as 1% body weight (BW) in two doses, i.e. in the morning at 06.00 and in the afternoon at 15.00. Forage and drinking water are provided on a measured ad libitum basis. The forage was given one hour after the concentrate was given. The treatment concentrates consisted of P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), and P4 (100%

LCC). The nutritional content of the feed given is shown in Table 1. The research design used was the Latin Square Design (LSD) with 4 treatments and 4 periods.

Feeding and residues of feed and drinking water to livestock were recorded in a logbook on a regular basis. The study was conducted in 4 periods, each period was carried out for 30 days of observation. The parameters measured were heart girth (HG), body length (BL), withers height (WH). Measurement of body dimensions were carried out at the beginning and end of the period based on Welboren *et al*. (2019) and Lardy *et al*. (2020), followed by a break for 5 days and continued to the next period.

Table 1. Nutrient Content of Feed

| Feed | Water | Ash | EE | CF | CP | NFE | TDN |
|---|---|---|---|---|---|---|---|
| | --(%)-- | | ----------(% DM)---------- | | | | |
| Lactation Cow Concentrate (LCC) | 9,42 | 9,90 | 6,42 | 26,87 | 16,40 | 40,41 | 64,91 |
| Calf Starter (CS) | 11,17 | 12,32 | 5,25 | 8,74 | 19,70 | 53,99 | 76,13 |
| Elephant Grass | 78,08 | 13,31 | 2,17 | 28,64 | 12,13 | 43,75 | 58,5 |
| P1 | 10,73 | 11,71 | 5,54 | 13,27 | 18,87 | 50,61 | 73,32 |
| P2 | 10,29 | 11,11 | 5,83 | 17,80 | 18,05 | 47,21 | 70,52 |
| P3 | 9,86 | 10,50 | 6,13 | 22,33 | 17,25 | 43,79 | 67,71 |
| P4 | 9,42 | 9,90 | 6,42 | 26,87 | 16,40 | 40,41 | 64,91 |

EE: ether extract, CF: crude fiber, CP: crude protein, NFE: nitrogen free extract, TDN: total digestible nutrients, DM: dry matter

**Statistical Analyses**

All data were analyzed using analysis of variance (ANOVA) based on Latin Square Design. If there was a treatment effect, then Duncan's test was continued to determine the difference between treatments.

## RESULTS AND DISCUSSION

The results of the study on the effect of substitution of calf starter on lactating cow

concentrate on body dimensions increase in post-weaning HF female calves are presented in Table 2. Treatment of calf starter substitution on lactating cow concentrate (P1, P2, P3, and P4) had no significant effect (P>0 0.05) to the average body size at the end of the study and the increase in body dimensions of livestock which includes heart girth, body length, and withers height. These results have the same phenomenon as research of Purwadi (2017) that giving concentrates with different protein content, i.e. 10.23% and 13.79% in post-weaning female calves aged 3.5 months gave no significant effect on body dimensions increase.

Table 2. Average Body Dimensions of Post-Weaning Female HF Calves

| Variables | Treatments | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| Initial Body Dimensions (cm) | | | | |
| Heart Girth | 116,92±8,45 | 115,25 ±13,58 | 114,55 ±9,84 | 115,40 ±6,30 |
| Body Length | 96,33 ±8,68 | 97,27 ±10,82 | 98,95 ±7,93 | 99,25 ±3,30 |
| Withers Height | 70,40 ±4,62 | 70,92 ±4,83 | 71,50 ±3,76 | 71,20 ±2,48 |
| Final Body Dimensions (cm) | | | | |
| Heart Girth | 119,23 ±7,82 | 119,48 ±12,25 | 119,15 ±7,46 | 119,50 ±6,46 |
| Body Length | 101,08 ±7,89 | 101,65 ±9,72 | 103,33 ±7,67 | 102,73 ±4,22 |
| Withers Height | 72,35 ±3,92 | 73,15 ±3,67 | 73,85 ±3,23 | 73,38 ±1,60 |
| Increase in Body Dimensions (cm/month) | | | | |
| Heart Girth | 2,31 ±1,36 | 4,23 ±1,85 | 4,60 ±2,81 | 4,10 ±1,13 |
| Body Length | 4,75 ±3,10 | 4,38 ±1,80 | 4,38 ±1,41 | 3,48 ±1,83 |
| Withers Height | 1,95 ±1,08 | 2,23 ±1,58 | 2,35 ±2,16 | 2,18 ±1,48 |

The increase in body size that did not differ between treatments could be caused by the relatively same amount of daily consumption so that the nutrients digested by the calves were also the same. The average DM consumption was also not significantly different, i.e. P1 3.43

kg/day, P2 3.54 kg/day, P3 3.58 kg/day and P4 3.34 kg/day. The substitution of calf starter was intended to make the nutritional content of concentrate feed for post-weaning calves better at smallholder farms when compared to feed from lactation cow concentrate alone. Forage feed was given in a measurable ad libitum with the aim of the calves being able to meet the nutritional deficiencies from consumption of concentrates by obtaining them from forage consumption. However, giving a concentrate that was 1% of body weight or with an forage : concentrate balance of 70 : 30 in this study, it was assumed that if the consumption of DM was relatively the same, the consumption of other nutrients was relatively the same as well. Nutrients from the feed digestion process in the form of energy, protein, fat, minerals, and so on will be used by the calf to meet the nutritional needs for calf growth. Imran *et al*. (2012) stated that the nutrients digested by the calf will be used to meet the needs to support the growth of the calf according to its genetics. Research by Kargar *et al*. (2019) also shows the body dimensions of post-weaning calves that were not different because the amount of DM consumption and the nutritional content consumed were relatively the same. According to Winarti and Widyastuti (2016), almost the same DM consumption will result in calf growth between treatments, there was no difference because the consumption of nutrients was almost the same, both from consumption of crude protein, crude fat (ether extract) and crude fiber.

The growth of the post-weaning calves is indicated by the increase in body dimensions. Calf body dimensions were strongly influenced by feeding, feed consumption and digestibility. The results of this study showed that the increase in body dimensions of post-weaning calves between treatments was relatively the same. This was presumably because during post-weaning the rumen conditions and functions have developed perfectly, so that the results of fermentative digestion of feed in the rumen that can be used for the growth of the post-weaning calves in each treatment were relatively the same, resulting in relatively the same body dimensions even though the calf starter has the better quality than lactation dairy

158 cow concentrate. This can be caused by the condition of the rumen in post-weaning calves
159 that are ready to digest solid feed. McCurdy *et al*. (2019) stated that when the calf has been
160 weaned, the calf rumen is ready to digest solid feed and the rumen becomes much more
161 sensitive to food fermentability. Rumen microbes were thought to have been able to ferment
162 concentrates and forage well, so that sufficient microbial protein was available for post-
163 weaning calves at P1, P2, P3 and P4. Pramita *et al*. (2016) stated that rumen microbes are the
164 main source of protein for the host, besides that rumen microbe play an important role in
165 digesting feed because they can produce enzymes that can digest fiber in low-quality feed.
166 The rumen of the post-weaning calves had a fairly complete set of microorganisms.
167 Xiao *et al*. (2016) stated that in the rumen of the calf there are fungi, protozoa, and bacteria
168 which include fiber-digesting bacteria such as *Fibrobacter succinogenes*, *Ruminococcus*
169 *albus*, and *Ruminococcus flavefaciens*, as well as other bacteria such as *Prevotella*,
170 *Butyrivibrio fibrisolvens*, *Shuttleworthia* and *Desulfovibrio*. In addition, there are two groups
171 of protozoa that are abundant in the rumen, i.e. entodiniomorphid (oligotrich) and holotrich
172 (Yanuartono *et al*., 2019). With a ready-made rumen condition, post-weaning calves are able
173 to properly utilize forage and concentrates to meet their nutritional needs. This resulted in the
174 administration of lactation cow concentrate with a CP content of 16.40% and TDN 64.91%
175 (P4), which resulted in an increase in body dimensions which was relatively the same as the
176 concentrate substituted of calf starter (P1, P2, P3), if accompanied by the administration of
177 optimal forage. In this study, post-weaning female HF calves received concentrate as much as
178 1% of BW and forage given ad libitum.
179
180 **Increase in Heart Girth (HG)**
181
182 The increase in heart girth of calves treated with calf starter substitution on lactation
183 cow concentrates were 2.31±1.36 cm/month (P1), 4.23±1.85 cm/month (P2), 4.60±2.81

cm/month (P3), and 4.10±1.13 cm/month (P4). These results were lower than the study results of Manthey *et al*. (2016) with the addition of DDGS treatment in concentrates with different concentrations in Holstein calves, i.e. an average of 5.22 cm/month, also the results of research by Wang *et al*. (2017) who gave a concentrate with a different physically effective neutral detergent fiber (peNDF) content in Holstein calves, i.e. 5.36 cm/month. Differences in the results of these studies can be caused by genetic influences, environmental climate, feed given, and maintenance management. This is in accordance with the statement of Ratnasari *et al*. (2019) that differences in growth in livestock can be caused by climate, genetic capabilities of each animal, maintenance and feed management.

Giving calf starter substitution in lactation cow concentrate had no effect on the increase in heart girth of post-weaning female HF calves ($P>0.05$). This condition may occur because the nutrition from the feed consumed by the calf has been used for bone growth, organ growth, and meat growth. This was in accordance with the opinion of Parsons *et al*. (2020) which stated that body size is closely related to body weight which is influenced by bone growth and then fat deposition. The growth of meat and bones affects the size of the heart girth, chest width, abdominal girth and body weight of livestock, while bone growth affects body length, withers height, and body weight of livestock. The increase in the size of the heart girth occurs because the heart girth is closely related to the body weight of the cattle, so that when the weight of the cattle increases, the heart girth will be even bigger, including in HF calves (Sulistyowati *et al*., 2009; Hardiono *et al*., 2016; Rotondo *et al*., 2021). Syaiful *et al*. (2020) stated that the bigger the heart girth, the bigger the organs in the chest cavity such as the heart and lungs, therefore heart girth can be used as an indicator of the calf body capacity.

**Increase in Body Length (BL)**

Giving calf starter substitution to lactation cow concentrate had no effect on the increase

in body length for post-weaning female HF calves (P>0.05). The results of each treatment were 4.75±3.10 cm/month (P1), 4.38±1.80 cm/month (P2), 4.38±1.41 cm/month (P3) and 3.48±1.83 cm/month (P4). This result was higher than the average result of Anderson *et al*. (2015) in the treatment of concentrates from grains with different fat and protein content in Holstein calves, which was an average of 3.93 cm/month, but lower than the average results of Wang *et al.* (2017) on concentrate treatment with different physically effective neutral detergent fiber (peNDF) content in Holstein calves, i.e. 6.15 cm/month. The results of these studies differ because they are caused by several factors, i.e. livestock age, genetics, feed quality, and maintenance management (Vavrisinova *et al*., 2019).

The size of the calf body length that did not differ, this was as a result of the treatment with calf starter substitution on lactation cow concentrate, could be due to genetic influences and almost the same age. This is in accordance with the research results of Senevirathne *et al*. (2016) that there was no difference between treatments for calf body dimensions, indicating that calves were in the same period so that the growth rate of their body skeletons did not differ. At the time the research was carried out, the calf was in the growth acceleration phase so that the feed consumed by the calf would be used maximally for the growth of its body frame. Putra and Fajrina (2020) stated that the maximum growth rate occurs when the calf is 4-8 months old. This was reinforced by the opinion of Nugraha *et al*. (2016) which stated that livestock growth is influenced by the feed given, if the feed provided is of good quality and in sufficient quantity, and then livestock growth will also be good.

**Increase in Withers Height (WH)**

Giving calf starter substitution to lactation cow concentrate did not have a different effect on the increase in withers height of post-weaning female HF calves (P>0.05). The treatment concentrate gave an increase in the size of the withers height by 1.95±1.08

cm/month (P1); 2.23±1.58 cm/month (P2); 2.35±2.16 cm/month (P3) and 2.18±1.48 cm/month (P4). This result was lower than the results of the study by Manthey and Anderson (2018) by giving corn and soybean-based concentrates (with ad libitum forage) to Holstein calves which resulted in an average increase in withers height of 3.03 cm/month. Differences in the results of this study can be influenced by factors such as age of livestock, environmental climate, feed given, and maintenance management (Place and Mitloehner, 2010).

The results of the increase in withers height which did not differ from all treatments with calf starter substitution in lactation cow concentrate were also due to the age of the calf which was in the early stages of growth so that the nutrients from the feed consumed were used for bone growth, including the forefoot bones that greatly affect the value of withers height. This was in accordance with the opinion of Syaiful *et al*. (2020) which stated that at the age of 0-6 months the calf experiences faster growth in its forelegs because the forelegs are used to actively move when the calf is suckle on its mother, in addition the forelegs are used to support the calf body weight. The increase in withers height is closely related to the growth of the calf skeletal bones. This was in accordance with the opinion of Maluhima *et al*. (2019) which stated that withers height is influenced by several factors, including feeding management, genetics, the condition of the livestock itself, and having a close relationship with the size of the calf frame.

## CONCLUSION

The substitution of calf starter on lactation cow concentrate did not have a different effect on the increase in body dimensions (heart girth, body length, withers height) of post-weaning female HF calves. Lactation cow concentrate with PK 16.40% and TDN 64.91%

followed by good quality forage in sufficient quantities was able to meet the nutritional needs of weaning calves seen from the performance of increasing body dimensions.

## CONFLICT OF INTEREST

There is no conflict of interest with financial, personal, or other relationship with other people or organizations associated with material discussed in the manuscript.

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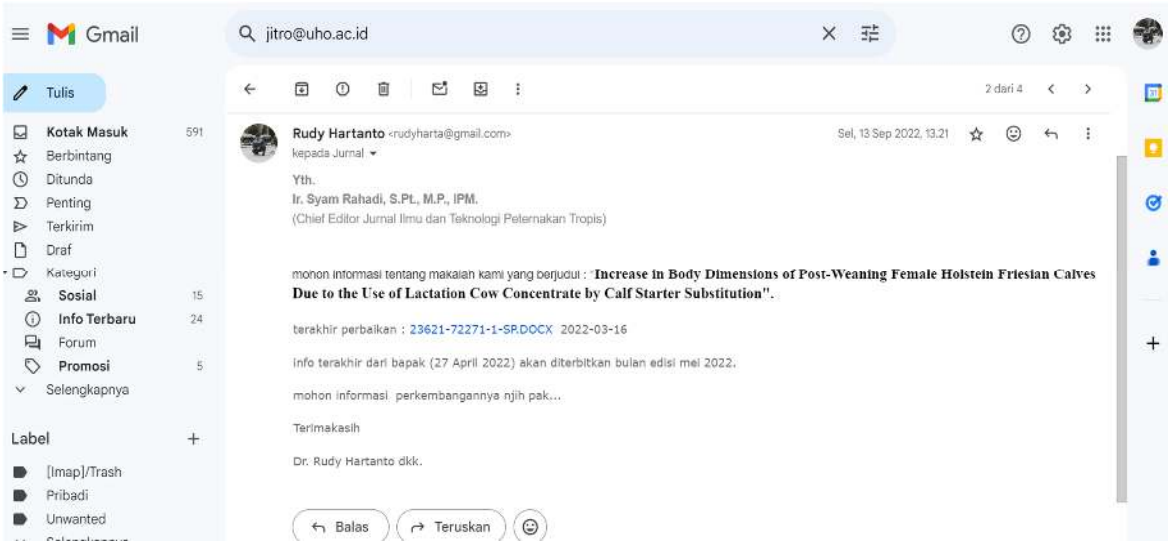

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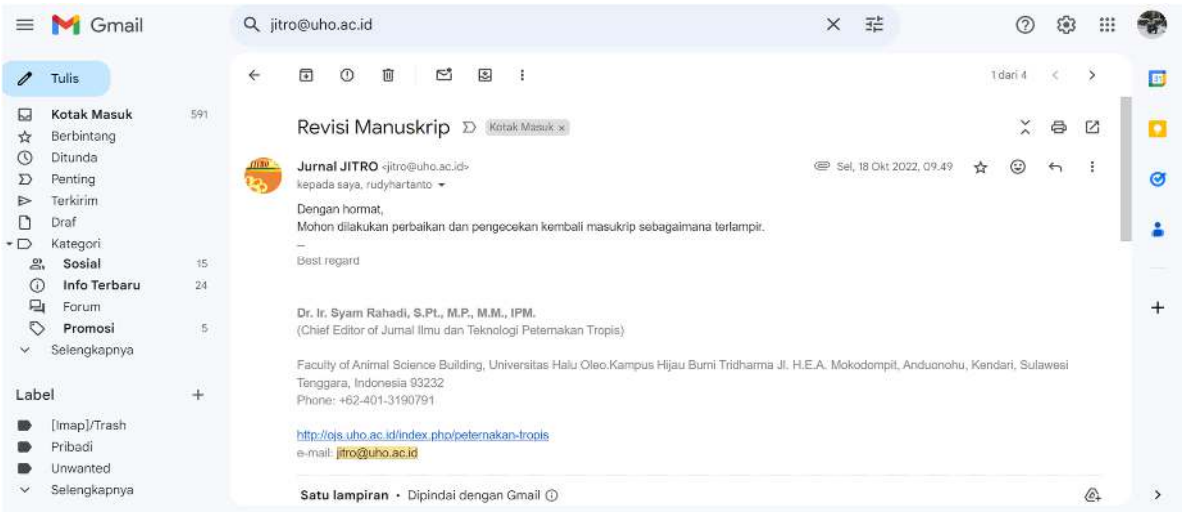


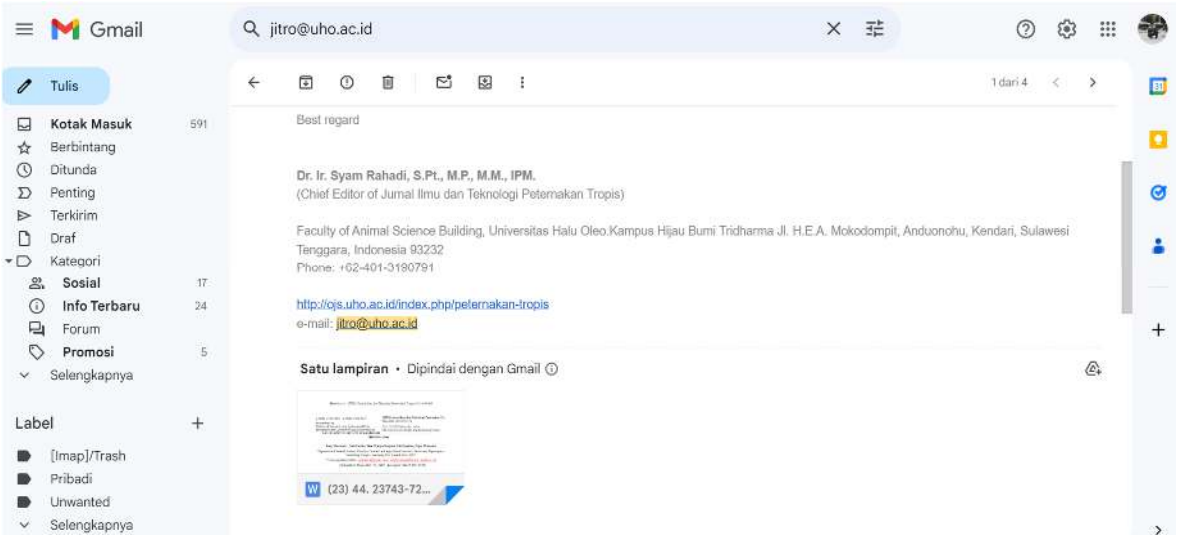

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# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Tembalang Campus, Semarang City, Central Java, 50275

*Corresponding author: rudyharta@gmail.com; rudyhartanto@lecturer.undip.ac.id

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## ABSTRACT

The aim of the study was to analyze the increase in body dimensions of post-weaning female Holstein Friesian (HF) calves fed with lactation cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass, calf starter (CS), and lactation cow concentrate (LCC). The study used a Latin square design, with 4 concentrate treatments, i.e. P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), P4 (100% LCC); and 4 replications in 4 periods (each period in 1 month). The concentrate was given 1% BW in the dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body dimensions (heart girth (HG), body length (BL), and withers height (WH)). The treatments had no significant effect ($p>0.05$) on the increase in body dimensions, were P1 (HG = 2.31 cm/month, BL = 4.75 cm/month, WH = 1.95 cm/month), P2 (HG = 4.23 cm/month, BL = 4.38 cm/month, WH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, WH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, WH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% LCC to post-weaning female HF calves could result in an increase in body dimensions that was relatively the same as the substitution of CS (25-75%) in LCC as concentrate feed.

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**Keywords:** post-weaning female HF calves, body dimensions, calf starter, lactation cow concentrate

## INTRODUCTION

Feeding and drinking as well as calf health are important factors that need to be considered in order to get good calf growth, both pre-weaning and after-weaning. Calves that have been weaned do not get milk and fulfill their nutritional needs in full from forages and concentrates (Kusumawati et al., 2018; Atabany et al., 2020). Calves can be weaned when they are 8 weeks old, i.e. after they are able to consume calf starter 0.5-0.68 kg/day, but at this age weaning has a high risk of calf death so that calves are generally weaned at 3 months of age (NRC, 2001; Prihantoro et al., 2012). When weaning, the calf enters the initial phase of growth, so most of the nutrients consumed will be used for growth such as enlargement of the body skeleton (Imran et al., 2012; Welboren et al., 2019).

The body dimensions of the female calf when weaning are very important because the female calf which from the start already has the ideal body dimensions, will also be an ideal breeder. In addition to body weight gain, the increase in body dimensions (heart girt, withers height, body length) in weaning calves is also a measure of the calf's appearance or performance (Hardiono et al., 2016; Rotondo et al., 2021). The calf when post-weaning should have a heart girt of 96 cm and a withers height of 75 cm so that later it can meet the target of a heart girt of 155 cm and withers height of 115 cm at the time of entering the age of 15 months for first mating (Alim and Hidaka, 2002). The formation of body dimensions is influenced by the adequacy of nutrient needs. Weaning calves are usually fed high-quality forage and concentrates formulated to meet nutritional needs and increase body weight (ASAS, 2020).

However, in practice in the field, the provision of feed for post-weaning female calves has not been well considered by small farmers. Generally, smallholder farms provide lactation cow concentrates to calves with the consideration of cheaper concentrate prices. At least lactation cow concentrate has a crude protein CP content is 16-21% and TDN of 70-80% (BSN, 2017). Whereas the nutritional needs of female calves from post-weaning to heifers are different from those of adult cattle, so calves need to be given different feeds from adult cows.

The substitution of calf starter in lactation cow concentrate was carried out with the aim of improving the nutritional quality of the concentrate feed given to weaning calves. Calf starter is different from lactation cow concentrate both physically and in quality (Mukodiningsih et al., 2012). Post-Weaning calves that receive higher-quality feed will produce better performance in body dimensions as well. Larger body weight and body dimensions at the same age indicate better growth (Turiello et al., 2016; Nemati et al., 2016).

This study aimed to analyze the increase in body dimensions of post-weaned female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of substitution of calf starter.

## MATERIAL AND METHOD

### Materials

The materials used were 4 post-weaning female Holstein Friesian (HF) calves aged 4-5 months with an average weight of 101.38±14.21 kg. The calves were kept in metabolic cages for the duration of the study. 300 cm long measuring tape with 0.1 cm accuracy and a 1.5 m stainless steel measuring stick with 0.1 cm accuracy were used to measure the body dimensions of livestock. The feed used was elephant grass (*Pennisetum purpureum)*, lactation cow concentrate (LCC), and calf starter (CS) produced by Teaching Farm FPP Undip.

### Methods

The feed provided was forage and concentrate treatment which was adjusted to the dry matter (DM) needs of the calves. Treatment concentrate (in DM) was given as much as 1% body weight (BW) in two doses, i.e. in the morning at 06.00 and in the afternoon at 15.00. Forage and drinking water are provided on a measured ad libitum basis. The forage was given one hour after the concentrate was given. The treatment concentrates consisted of P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), and P4 (100% LCC). The nutritional content of the feed given is shown in Table 1. The research design used was the Latin Square Design (LSD) with 4 treatments and 4 periods.

Feeding and residues of feed and drinking water to livestock were recorded in a logbook on a regular basis. The study was conducted in 4 periods, each period was carried out for 30 days of observation. The parameters measured were heart girth (HG), body length (BL), and withers height (WH). Measurement of body dimensions was carried out at the beginning and end of the period based on Welboren et al. (2019) and Lardy et al. (2020), followed by a break for 5 days and continued to the next period.

### Statistical Analyses

All data were analyzed using analysis of variance (ANOVA) based on the Latin Square Design. If there was a treatment effect, then Duncan's test was continued to determine the difference between treatments.

Table 1. Nutrient content of feed

| Feed | Water | Ash | EE | CF | CP | NFE | TDN |
|---|---|---|---|---|---|---|---|
| | --(%)-- | ---------- (% DM) ---------- | | | | | |
| Lactation Cow Concentrate (LCC) | 9,42 | 9,90 | 6,42 | 26,87 | 16,40 | 40,41 | 64,91 |
| Calf Starter (CS) | 11,17 | 12,32 | 5,25 | 8,74 | 19,70 | 53,99 | 76,13 |
| Elephant Grass | 78,08 | 13,31 | 2,17 | 28,64 | 12,13 | 43,75 | 58,5 |
| P1 | 10,73 | 11,71 | 5,54 | 13,27 | 18,87 | 50,61 | 73,32 |
| P2 | 10,29 | 11,11 | 5,83 | 17,80 | 18,05 | 47,21 | 70,52 |
| P3 | 9,86 | 10,50 | 6,13 | 22,33 | 17,25 | 43,79 | 67,71 |
| P4 | 9,42 | 9,90 | 6,42 | 26,87 | 16,40 | 40,41 | 64,91 |

Note: EE = ether extract, CF = crude fiber, CP = crude protein, NFE = nitrogen free extract, TDN = total digestible nutrients, DM = dry matter

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## RESULTS AND DISCUSSION

The results of the study on the effect of substitution of calf starter on lactating cow concentrate on body dimensions increase in post-weaning HF female calves are presented in Table 2. Treatment of calf starter substitution on lactating cow concentrate (P1, P2, P3, and P4) had no significant effect (p>0 0.05) on the average body size at the end of the study and the increase in body dimensions of livestock which includes heart girth, body length, and withers height. These results have the same phenomenon as the research of Purwadi (2017) that giving concentrates with different protein content, i.e. 10.23% and 13.79% in post-weaning female calves aged 3.5 months gave no significant effect on body dimensions increase.

The increase in body size that did not differ between treatments could be caused by the relatively same amount of daily consumption so that the nutrients digested by the calves were also the same. The average DM consumption was also not significantly different, i.e. P1 3.43 kg/day, P2 3.54 kg/day, P3 3.58 kg/day and P4 3.34 kg/day. The substitution of calf starter was intended to make the nutritional content of concentrate feed for post-weaning calves better at smallholder farms when compared to feed from lactation cow concentrate alone. Forage feed was given in a measurable ad libitum with the aim of the calves being able to meet the nutritional deficiencies from the consumption of concentrates by obtaining them from forage consumption. However, giving a concentrate that was 1% of body weight or with a forage: concentrate balance of 70:30 in this study, it was assumed that if the consumption of DM was relatively the same, the consumption of other nutrients was relatively the same as well. Nutrients from the feed digestion process in the form of energy, protein, fat, minerals, and so on will be used by the calf to meet the nutritional needs for calf growth. Imran et al. (2012) stated that the nutrients digested by the calf will be used to meet the needs to support the growth of the calf according to its genetics. Research by Kargar et al. (2019) also shows the body dimensions of post-weaning calves that were not different because the amount of DM consumption and the nutritional content consumed were relatively the same. According to Winarti and Widyastuti (2016), almost the same DM consumption will result in calf growth between treatments, there was no difference because the consumption of nutrients was almost the same, both from consumption of crude protein, crude fat (ether extract) and crude fiber.

The growth of the post-weaning calves is indicated by the increase in body dimensions. Calf body dimensions were strongly influenced by feeding, feed consumption and digestibility. The results of this study showed that the increase in body dimensions of post-weaning calves between treatments was relatively the same. This was presumably because during post-weaning the rumen conditions and functions have developed perfectly, so that the results of fermentative digestion of feed in the rumen that can be used for the growth of the post-weaning calves in each treatment were relatively the same, resulting in relatively the same body dimensions even though the calf starter has the better quality than lactation dairy cow concentrate. This can be caused by the condition of the rumen in post-weaning calves that are ready to digest solid feed. McCurdy et al. (2019) stated that when the calf has been weaned, the calf rumen is ready to digest solid feed and the rumen becomes much more sensitive to food fermentability. Rumen microbes were thought to have been able to ferment concentrates and forage well, so that sufficient microbial protein was available for post-weaning calves at P1, P2, P3 and P4. Pramita et al. (2016) stated that rumen microbes are the main source of protein for the host, besides that rumen microbes play an important role in digesting feed because they can produce enzymes that can digest fiber in low-quality feed.

The rumen of the post-weaning calves had a fairly complete set of microorganisms. Xiao et al. (2016) stated that in the rumen of the calf there are fungi, protozoa, and bacteria which include fiber-digesting bacteria such as *Fibrobacter succinogenes*, *Ruminococcus albus*, and *Ruminococcus flavefaciens*, as well as other bacteria such as Prevotella, Butyrivibrio fibrisolvens, Shuttleworthia, and Desulfovibrio. In addition, there are two groups of protozoa that are abundant in the rumen, i.e. entodiniomorphid (oligotrich) and holotrich (Yanuartono et al., 2019). With a ready-made rumen condition, post-weaning calves are able to properly utilize forage and concentrates to meet their nutritional needs. This resulted in the administration of lactation cow concentrate with a CP content of 16.40% and TDN of 64.91% (P4), which resulted in an increase in body dimensions that was relatively the same as the concentrate substituted of calf starter (P1, P2, P3) if accompanied by the

administration of optimal forage. In this study, post-weaning female HF calves received concentrate as much as 1% of BW and forage given ad libitum.

Table 2. Average body dimensions of post-weaning female HF calves

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| Variables | Treatments | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| Initial Body Dimensions (cm) | | | | |
| Heart Girth | 116,92±8,45 | 115,25 ±13,58 | 114,55 ±9,84 | 115,40 ±6,30 |
| Body Length | 96,33 ±8,68 | 97,27 ±10,82 | 98,95 ±7,93 | 99,25 ±3,30 |
| Withers Height | 70,40 ±4,62 | 70,92 ±4,83 | 71,50 ±3,76 | 71,20 ±2,48 |
| Final Body Dimensions (cm) | | | | |
| Heart Girth | 119,23 ±7,82 | 119,48 ±12,25 | 119,15 ±7,46 | 119,50 ±6,46 |
| Body Length | 101,08 ±7,89 | 101,65 ±9,72 | 103,33 ±7,67 | 102,73 ±4,22 |
| Withers Height | 72,35 ±3,92 | 73,15 ±3,67 | 73,85 ±3,23 | 73,38 ±1,60 |
| Increase in Body Dimensions (cm/month) | | | | |
| Heart Girth | 2,31 ±1,36 | 4,23 ±1,85 | 4,60 ±2,81 | 4,10 ±1,13 |
| Body Length | 4,75 ±3,10 | 4,38 ±1,80 | 4,38 ±1,41 | 3,48 ±1,83 |
| Withers Height | 1,95 ±1,08 | 2,23 ±1,58 | 2,35 ±2,16 | 2,18 ±1,48 |

**Increase in Heart Girth (HG)**

The increase in heart girth of calves treated with calf starter substitution on lactation cow concentrates was 2.31±1.36 cm/month (P1), 4.23±1.85 cm/month (P2), 4.60±2.81 cm/month (P3), and 4.10±1.13 cm/month (P4). These results were lower than the study results of Manthey et al. (2016) with the addition of DDGS treatment in concentrates with different concentrations in Holstein's calves, i.e. an average of 5.22 cm/month, also the results of research by Wang et al. (2017) who gave a concentrate with a different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 5.36 cm/month. Differences in the results of these studies can be caused by genetic influences, environmental climate, feed given, and maintenance management. This is in accordance with the statement of Ratnasari et al. (2019) that differences in growth in livestock can be caused by climate, the genetic capabilities of each animal, maintenance, and feed management.

Giving calf starter substitution in lactation cow concentrate had no effect on the increase in heart girth of post-weaning female HF calves ($p>0.05$). This condition may occur because the nutrition from the feed consumed by the calf has been used for bone growth, organ growth, and meat growth. This was in accordance with the opinion of Parsons et al. (2020) who stated that body size is closely related to body weight which is influenced by bone growth and then fat deposition. The growth of meat and bones affects the size of the heart girth, chest width, abdominal girth, and body weight of livestock, while bone growth affects body length, withers height, and body weight of livestock. The increase in the size of the heart girth occurs because the heart girth is closely related to the body weight of the cattle, so when the weight of the cattle increases, the heart girth will be even bigger, including in HF calves (Sulistyowati et al., 2009; Hardiono et al., 2016; Rotondo et al., 2021). Syaiful et al. (2020) stated that the bigger the heart girth, the bigger the organs in the chest cavity such as the heart and lungs, therefore heart girth can be used as an indicator of the calf body capacity.

**Increase in Body Length (BL)**

Giving calf starter substitution to lactation cow concentrate had no effect on the increase in body length for post-weaning female HF calves ($p>0.05$). The results of each treatment were 4.75±3.10 cm/month (P1), 4.38±1.80 cm/month (P2), 4.38±1.41 cm/month (P3) and 3.48±1.83 cm/month (P4). This result was higher than the average result of Anderson et al. (2015) in the treatment of concentrates from grains with different fat and protein content in Holstein calves, which was an average of 3.93 cm/month, but lower than the average results of Wang et al. (2017) on concentrate treatment with different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 6.15 cm/month. The results of these studies differ because they are caused by several factors, i.e. livestock age, genetics, feed quality, and maintenance management (Vavrisinova et al., 2019).

The size of the calf's body length did not differ, this was a result of the treatment with calf starter substitution on lactation cow concentrate,

which could be due to genetic influences and almost the same age. This is in accordance with the research results of Senevirathne et al. (2016) that there was no difference between treatments for calf body dimensions, indicating that calves were in the same period so that the growth rate of their body skeletons did not differ. At the time the research was carried out, the calf was in the growth acceleration phase so that the feed consumed by the calf would be used maximally for the growth of its body frame. Putra and Fajrina (2020) stated that the maximum growth rate occurs when the calf is 4-8 months old. This was reinforced by the opinion of Nugraha et al. (2016) who stated that livestock growth is influenced by the feed given, if the feed provided is of good quality and in sufficient quantity, then livestock growth will also be good.

**Increase in Withers Height (WH)**

Giving calf starter substitution to lactation cow concentrate did not have a different effect on the increase in withers height of post-weaning female HF calves ($p>0.05$). The treatment concentrate gave an increase in the size of the wither's height by 1.95±1.08 cm/month (P1); 2.23±1.58 cm/month (P2); 2.35±2.16 cm/month (P3) and 2.18±1.48 cm/month (P4). This result was lower than the results of the study by Manthey and Anderson (2018) by giving corn and soybean-based concentrates (with ad libitum forage) to Holstein's calves which resulted in an average increase in withers height of 3.03 cm/month. Differences in the results of this study can be influenced by factors such as the age of livestock, environmental climate, feed given, and maintenance management (Place & Mitloehner, 2010).

The results of the increase in wither height which did not differ from all treatments with calf starter substitution in lactation cow concentrate were also due to the age of the calf which was in the early stages of growth so that the nutrients from the feed consumed were used for bone growth, including the forefoot bones that greatly affect the value of withers height. This was in accordance with the opinion of Syaiful et al. (2020) which stated that at the age of 0-6 months the calf experiences faster growth in its forelegs because the forelegs are used to actively move when the calf is suckling on its mother, in addition, the forelegs are used to support the calf body weight. The increase in wither height is closely related to the growth of the calf's skeletal bones. This was in accordance with the opinion of Maluhima et al. (2019) who stated that withers height is influenced by several factors, including feeding management, genetics, the condition of the livestock itself, and having a close relationship with the size of the calf frame.

## CONCLUSION

The substitution of calf starter on lactation cow concentrate did not have a different effect on the increase in body dimensions (heart girth, body length, withers height) of post-weaning female HF calves. Lactation cow concentrate with PK 16.40% and TDN 64.91% followed by good quality forage in sufficient quantities was able to meet the nutritional needs of weaning calves seen from the performance of increasing body dimensions.

## CONFLICT OF INTEREST

There is no conflict of interest with financial, personal, or other relationship with other people or organizations associated with material discussed in the manuscript.

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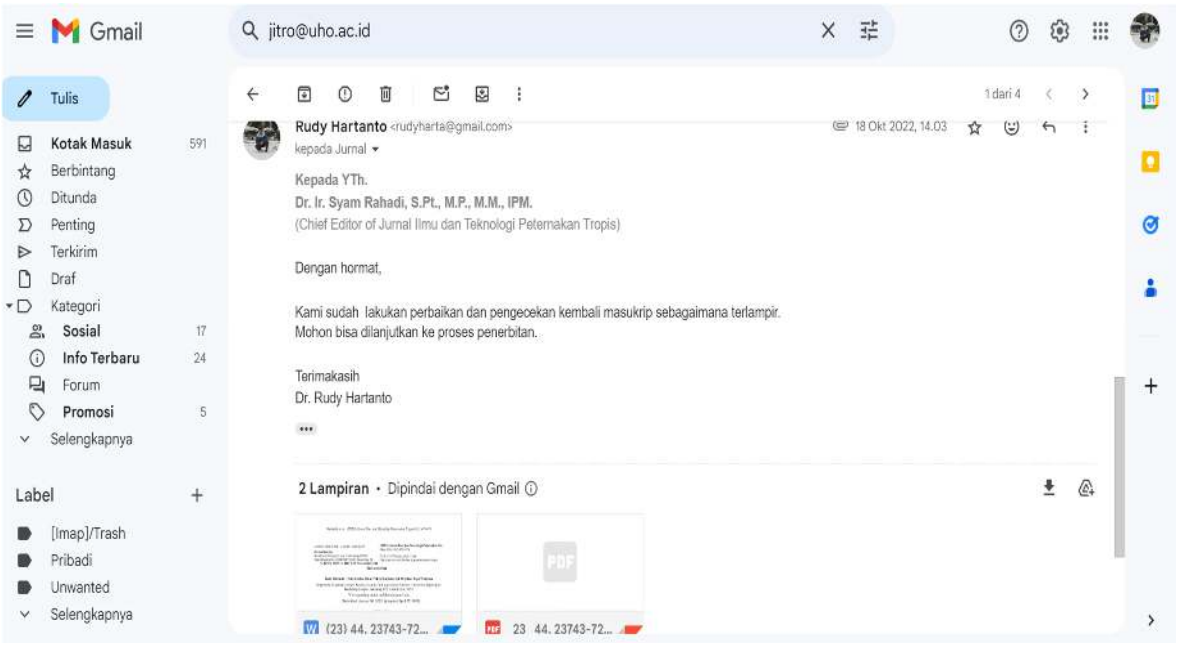

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# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Tembalang Campus, Semarang City, Central Java, 50275

*Corresponding author: rudyharta@gmail.com

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## ABSTRACT

The aim of the study was to analyze the increase in body dimensions of post-weaning female Holstein Friesian (HF) calves fed with lactation cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass, calf starter (CS), and lactation cow concentrate (LCC). The study used a Latin square design, with 4 concentrate treatments, i.e. P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), P4 (100% LCC); and 4 replications in 4 periods (each period in 1 month). The concentrate was given 1% BW in the dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body dimensions (heart girth (HG), body length (BL), and withers height (WH)). The treatments had no significant effect ($p>0.05$) on the increase in body dimensions, were P1 (HG = 2.31 cm/month, BL = 4.75 cm/month, WH = 1.95 cm/month), P2 (HG = 4.23 cm/month, BL = 4.38 cm/month, WH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, WH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, WH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% LCC to post-weaning female HF calves could result in an increase in body dimensions that was relatively the same as the substitution of CS (25-75%) in LCC as concentrate feed.

**Keywords:** post-weaning female HF calves, body dimensions, calf starter, lactation cow concentrate

## INTRODUCTION

Feeding and drinking as well as calf health are important factors that need to be considered in order to get good calf growth, both pre-weaning and after-weaning. Calves that have been weaned do not get milk and fulfill their nutritional needs in full from forages and concentrates (Kusumawati et al., 2018; Atabany et al., 2020). Calves can be weaned when they are 8 weeks old, i.e. after they are able to consume calf starter 0.5-0.68 kg/day, but at this age weaning has a high risk of calf death so that calves are generally weaned at 3 months of age (NRC, 2001; Prihantoro et al., 2012). When weaning, the calf enters the initial phase of growth, so most of the nutrients consumed will be used for growth such as enlargement of the body skeleton (Imran et al., 2012; Welboren et al., 2019).

The body dimensions of the female calf when weaning are very important because the female calf which from the start already has the ideal body dimensions, will also be an ideal breeder. In addition to body weight gain, the increase in body dimensions (heart girt, withers height, body length) in weaning calves is also a measure of the calf's appearance or performance (Hardiono et al., 2016; Rotondo et al., 2021). The calf when post-weaning should have a heart girt of 96 cm and a withers height of 75 cm so that later it can meet the target of a heart girt of 155 cm and withers height of 115 cm at the time of entering the age of 15 months for first mating (Alim and Hidaka, 2002). The formation of body dimensions is influenced by the adequacy of nutrient needs. Weaning calves are usually fed high-quality forage and concentrates formulated to meet nutritional needs and increase body weight (ASAS, 2020).

However, in practice in the field, the provision of feed for post-weaning female calves has not been well considered by small farmers. Generally, smallholder farms provide lactation cow concentrates to calves with the consideration of cheaper concentrate prices. At least lactation cow concentrate has a crude protein CP content is 16-21% and TDN of 70-80% (BSN, 2017). Whereas the nutritional needs of female calves from post-weaning to heifers are different from those of adult cattle, so calves need to be given different feeds from adult cows.

The substitution of calf starter in lactation cow concentrate was carried out with the aim of improving the nutritional quality of the concentrate feed given to weaning calves. Calf starter is different from lactation cow concentrate both physically and in quality (Mukodiningsih et al., 2012). Post-Weaning calves that receive higher-quality feed will produce better performance in body dimensions as well. Larger body weight and body dimensions at the same age indicate better growth (Turiello et al., 2016; Nemati et al., 2016).

This study aimed to analyze the increase in body dimensions of post-weaned female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of substitution of calf starter.

## MATERIAL AND METHOD

### Materials

The materials used were 4 post-weaning female Holstein Friesian (HF) calves aged 4-5 months with an average weight of 101.38±14.21 kg. The calves were kept in metabolic cages for the duration of the study. 300 cm long measuring tape with 0.1 cm accuracy and a 1.5 m stainless steel measuring stick with 0.1 cm accuracy were used to measure the body dimensions of livestock. The feed used was elephant grass (*Pennisetum purpureum)*, lactation cow concentrate (LCC), and calf starter (CS) produced by Teaching Farm FPP Undip.

### Methods

The feed provided was forage and concentrate treatment which was adjusted to the dry matter (DM) needs of the calves. Treatment concentrate (in DM) was given as much as 1% body weight (BW) in two doses, i.e. in the morning at 06.00 and in the afternoon at 15.00. Forage and drinking water are provided on a measured ad libitum basis. The forage was given one hour after the concentrate was given. The treatment concentrates consisted of P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), and P4 (100% LCC). The nutritional content of the feed given is shown in Table 1. The research design used was the Latin Square Design (LSD) with 4 treatments and 4 periods.

Feeding and residues of feed and drinking water to livestock were recorded in a logbook on a regular basis. The study was conducted in 4 periods, each period was carried out for 30 days of observation. The parameters measured were heart girth (HG), body length (BL), and withers height (WH). Measurement of body dimensions was carried out at the beginning and end of the period based on Welboren et al. (2019) and Lardy et al. (2020), followed by a break for 5 days and continued to the next period.

### Statistical Analyses

All data were analyzed using analysis of variance (ANOVA) based on the Latin Square Design. If there was a treatment effect, then Duncan's test was continued to determine the difference between treatments.

Table 1. Nutrient content of feed

| Feed | Water | Ash | EE | CF | CP | NFE | TDN |
|---|---|---|---|---|---|---|---|
| | --(%)-- | | ---------- (% DM) ---------- | | | | |
| Lactation Cow Concentrate (LCC) | 9.42 | 9.90 | 6.42 | 26.87 | 16.40 | 40.41 | 64.91 |
| Calf Starter (CS) | 11.17 | 12.32 | 5.25 | 8.74 | 19.70 | 53.99 | 76.13 |
| Elephant Grass | 78.08 | 13.31 | 2.17 | 28.64 | 12.13 | 43.75 | 58.5 |
| P1 | 10.73 | 11.71 | 5.54 | 13.27 | 18.87 | 50.61 | 73.32 |
| P2 | 10.29 | 11.11 | 5.83 | 17.80 | 18.05 | 47.21 | 70.52 |
| P3 | 9.86 | 10.50 | 6.13 | 22.33 | 17.25 | 43.79 | 67.71 |
| P4 | 9.42 | 9.90 | 6.42 | 26.87 | 16.40 | 40.41 | 64.91 |

Note: EE = ether extract, CF = crude fiber, CP = crude protein, NFE = nitrogen free extract, TDN = total digestible nutrients, DM = dry matter

## RESULTS AND DISCUSSION

The results of the study on the effect of substitution of calf starter on lactating cow concentrate on body dimensions increase in post-weaning HF female calves are presented in Table 2. Treatment of calf starter substitution on lactating cow concentrate (P1, P2, P3, and P4) had no significant effect (p>0 0.05) on the average body size at the end of the study and the increase in body dimensions of livestock which includes heart girth, body length, and withers height. These results have the same phenomenon as the research of Purwadi (2017) that giving concentrates with different protein content, i.e. 10.23% and 13.79% in post-weaning female calves aged 3.5 months gave no significant effect on body dimensions increase.

The increase in body size that did not differ between treatments could be caused by the relatively same amount of daily consumption so that the nutrients digested by the calves were also the same. The average DM consumption was also not significantly different, i.e. P1 3.43 kg/day, P2 3.54 kg/day, P3 3.58 kg/day and P4 3.34 kg/day. The substitution of calf starter was intended to make the nutritional content of concentrate feed for post-weaning calves better at smallholder farms when compared to feed from lactation cow concentrate alone. Forage feed was given in a measurable ad libitum with the aim of the calves being able to meet the nutritional deficiencies from the consumption of concentrates by obtaining them from forage consumption. However, giving a concentrate that was 1% of body weight or with a forage: concentrate balance of 70:30 in this study, it was assumed that if the consumption of DM was relatively the same, the consumption of other nutrients was relatively the same as well. Nutrients from the feed digestion process in the form of energy, protein, fat, minerals, and so on will be used by the calf to meet the nutritional needs for calf growth. Imran et al. (2012) stated that the nutrients digested by the calf will be used to meet the needs to support the growth of the calf according to its genetics. Research by Kargar et al. (2019) also shows the body dimensions of post-weaning calves that were not different because the amount of DM consumption and the nutritional content consumed were relatively the same. According to Winarti and Widyastuti (2016), almost the same DM consumption will result in calf growth between treatments, there was no difference because the consumption of nutrients was almost the same, both from consumption of crude protein, crude fat (ether extract) and crude fiber.

The growth of the post-weaning calves is indicated by the increase in body dimensions. Calf body dimensions were strongly influenced by feeding, feed consumption and digestibility. The results of this study showed that the increase in body dimensions of post-weaning calves between treatments was relatively the same. This was presumably because during post-weaning the rumen conditions and functions have developed perfectly, so that the results of fermentative digestion of feed in the rumen that can be used for the growth of the post-weaning calves in each treatment were relatively the same, resulting in relatively the same body dimensions even though the calf starter has the better quality than lactation dairy cow concentrate. This can be caused by the condition of the rumen in post-weaning calves that are ready to digest solid feed. McCurdy et al. (2019) stated that when the calf has been weaned, the calf rumen is ready to digest solid feed and the rumen becomes much more sensitive to food fermentability. Rumen microbes were thought to have been able to ferment concentrates and forage well, so that sufficient microbial protein was available for post-weaning calves at P1, P2, P3 and P4. Pramita et al. (2016) stated that rumen microbes are the main source of protein for the host, besides that rumen microbes play an important role in digesting feed because they can produce enzymes that can digest fiber in low-quality feed.

The rumen of the post-weaning calves had a fairly complete set of microorganisms. Xiao et al. (2016) stated that in the rumen of the calf there are fungi, protozoa, and bacteria which include fiber-digesting bacteria such as *Fibrobacter succinogenes*, *Ruminococcus albus*, and *Ruminococcus flavefaciens*, as well as other bacteria such as Prevotella, Butyrivibrio fibrisolvens, Shuttleworthia, and Desulfovibrio. In addition, there are two groups of protozoa that are abundant in the rumen, i.e. entodiniomorphid (oligotrich) and holotrich (Yanuartono et al., 2019). With a ready-made rumen condition, post-weaning calves are able to properly utilize forage and concentrates to meet their nutritional needs. This resulted in the administration of lactation cow concentrate with a CP content of 16.40% and TDN of 64.91% (P4), which resulted in an increase in body dimensions that was relatively the same as the concentrate substituted of calf starter (P1, P2, P3) if accompanied by the

administration of optimal forage. In this study, post-weaning female HF calves received concentrate as much as 1% of BW and forage given ad libitum.

Table 2. Average body dimensions of post-weaning female HF calves

| Variables | Treatments | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| Initial Body Dimensions (cm) | | | | |
| Heart Girth | 116.92±8.45 | 115.25 ±13.58 | 114.55 ±9.84 | 115.40 ±6.30 |
| Body Length | 96.33 ±8.68 | 97.27 ±10.82 | 98.95 ±7.93 | 99.25 ±3.30 |
| Withers Height | 70.40 ±4.62 | 70.92 ±4.83 | 71.50 ±3.76 | 71.20 ±2.48 |
| Final Body Dimensions (cm) | | | | |
| Heart Girth | 119.23 ±7.82 | 119.48 ±12.25 | 119.15 ±7.46 | 119.50 ±6.46 |
| Body Length | 101.08 ±7.89 | 101.65 ±9.72 | 103.33 ±7.67 | 102.73 ±4.22 |
| Withers Height | 72.35 ±3.92 | 73.15 ±3.67 | 73.85 ±3.23 | 73.38 ±1.60 |
| Increase in Body Dimensions (cm/month) | | | | |
| Heart Girth | 2.31 ±1.36 | 4.23 ±1.85 | 4.60 ±2.81 | 4.10 ±1.13 |
| Body Length | 4.75 ±3.10 | 4.38 ±1.80 | 4.38 ±1.41 | 3.48 ±1.83 |
| Withers Height | 1.95 ±1.08 | 2.23 ±1.58 | 2.35 ±2.16 | 2.18 ±1.48 |

**Increase in Heart Girth (HG)**

The increase in heart girth of calves treated with calf starter substitution on lactation cow concentrates was 2.31±1.36 cm/month (P1), 4.23±1.85 cm/month (P2), 4.60±2.81 cm/month (P3), and 4.10±1.13 cm/month (P4). These results were lower than the study results of Manthey et al. (2016) with the addition of DDGS treatment in concentrates with different concentrations in Holstein's calves, i.e. an average of 5.22 cm/month, also the results of research by Wang et al. (2017) who gave a concentrate with a different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 5.36 cm/month. Differences in the results of these studies can be caused by genetic influences, environmental climate, feed given, and maintenance management. This is in accordance with the statement of Ratnasari et al. (2019) that differences in growth in livestock can be caused by climate, the genetic capabilities of each animal, maintenance, and feed management.

Giving calf starter substitution in lactation cow concentrate had no effect on the increase in heart girth of post-weaning female HF calves ($p>0.05$). This condition may occur because the nutrition from the feed consumed by the calf has been used for bone growth, organ growth, and meat growth. This was in accordance with the opinion of Parsons et al. (2020) who stated that body size is closely related to body weight which is influenced by bone growth and then fat deposition. The growth of meat and bones affects the size of the heart girth, chest width, abdominal girth, and body weight of livestock, while bone growth affects body length, withers height, and body weight of livestock. The increase in the size of the heart girth occurs because the heart girth is closely related to the body weight of the cattle, so when the weight of the cattle increases, the heart girth will be even bigger, including in HF calves (Sulistyowati et al., 2009; Hardiono et al., 2016; Rotondo et al., 2021). Syaiful et al. (2020) stated that the bigger the heart girth, the bigger the organs in the chest cavity such as the heart and lungs, therefore heart girth can be used as an indicator of the calf body capacity.

**Increase in Body Length (BL)**

Giving calf starter substitution to lactation cow concentrate had no effect on the increase in body length for post-weaning female HF calves ($p>0.05$). The results of each treatment were 4.75±3.10 cm/month (P1), 4.38±1.80 cm/month (P2), 4.38±1.41 cm/month (P3) and 3.48±1.83 cm/month (P4). This result was higher than the average result of Anderson et al. (2015) in the treatment of concentrates from grains with different fat and protein content in Holstein calves, which was an average of 3.93 cm/month, but lower than the average results of Wang et al. (2017) on concentrate treatment with different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 6.15 cm/month. The results of these studies differ because they are caused by several factors, i.e. livestock age, genetics, feed quality, and maintenance management (Vavrisinova et al., 2019).

The size of the calf's body length did not differ, this was a result of the treatment with calf starter substitution on lactation cow concentrate,

which could be due to genetic influences and almost the same age. This is in accordance with the research results of Senevirathne et al. (2016) that there was no difference between treatments for calf body dimensions, indicating that calves were in the same period so that the growth rate of their body skeletons did not differ. At the time the research was carried out, the calf was in the growth acceleration phase so that the feed consumed by the calf would be used maximally for the growth of its body frame. Putra and Fajrina (2020) stated that the maximum growth rate occurs when the calf is 4-8 months old. This was reinforced by the opinion of Nugraha et al. (2016) who stated that livestock growth is influenced by the feed given, if the feed provided is of good quality and in sufficient quantity, then livestock growth will also be good.

**Increase in Withers Height (WH)**

Giving calf starter substitution to lactation cow concentrate did not have a different effect on the increase in withers height of post-weaning female HF calves ($p>0.05$). The treatment concentrate gave an increase in the size of the wither's height by 1.95±1.08 cm/month (P1); 2.23±1.58 cm/month (P2); 2.35±2.16 cm/month (P3) and 2.18±1.48 cm/month (P4). This result was lower than the results of the study by Manthey and Anderson (2018) by giving corn and soybean-based concentrates (with ad libitum forage) to Holstein's calves which resulted in an average increase in withers height of 3.03 cm/month. Differences in the results of this study can be influenced by factors such as the age of livestock, environmental climate, feed given, and maintenance management (Place & Mitloehner, 2010).

The results of the increase in wither height which did not differ from all treatments with calf starter substitution in lactation cow concentrate were also due to the age of the calf which was in the early stages of growth so that the nutrients from the feed consumed were used for bone growth, including the forefoot bones that greatly affect the value of withers height. This was in accordance with the opinion of Syaiful et al. (2020) which stated that at the age of 0-6 months the calf experiences faster growth in its forelegs because the forelegs are used to actively move when the calf is suckling on its mother, in addition, the forelegs are used to support the calf body weight. The increase in wither height is closely related to the growth of the calf's skeletal bones. This was in accordance with the opinion of Maluhima et al. (2019) who stated that withers height is influenced by several factors, including feeding management, genetics, the condition of the livestock itself, and having a close relationship with the size of the calf frame.

## CONCLUSION

The substitution of calf starter on lactation cow concentrate did not have a different effect on the increase in body dimensions (heart girth, body length, withers height) of post-weaning female HF calves. Lactation cow concentrate with PK 16.40% and TDN 64.91% followed by good quality forage in sufficient quantities was able to meet the nutritional needs of weaning calves seen from the performance of increasing body dimensions.

## CONFLICT OF INTEREST

There is no conflict of interest with financial, personal, or other relationship with other people or organizations associated with material discussed in the manuscript.

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# HASIL UJI SIMILIARITY

# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

*by* Rudy Hartanto

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# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro Tembalang Campus, Semarang City 50275, Central Java

*Corresponding author: rudyharta@gmail.com

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## ABSTRACT

The aim of the study was to analyze the increase in body dimensions of post-weaning female Holstein Friesian (HF) calves fed with lactation cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass, calf starter (CS), and lactation cow concentrate (LCC). The study used a Latin square design, with 4 concentrate treatments, i.e. P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), P4 (100% LCC); and 4 replications in 4 periods (each period in 1 month). The concentrate was given 1% BW in the dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body dimensions (heart girth (HG), body length (BL), and withers height (WH)). The treatments had no significant effect ($p>0.05$) on the increase in body dimensions, were P1 (HG = 2.31 cm/month, BL = 4.75 cm/month, WH = 1.95 cm/month), P2 (HG = 4.23 cm/month, BL = 4.38 cm/month, WH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, WH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, WH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% LCC to post-weaning female HF calves could result in an increase in body dimensions that was relatively the same as the substitution of CS (25-75%) in LCC as concentrate feed.

**Keywords:** post-weaning female HF calves, body dimensions, calf starter, lactation cow concentrate

## INTRODUCTION

Feeding and drinking as well as calf health are important factors that need to be considered in order to get good calf growth, both pre-weaning and after-weaning. Calves that have been weaned do not get milk and fulfill their nutritional needs in full from forages and concentrates (Kusumawati et al., 2018; Atabany et al., 2020). Calves can be weaned when they are 8 weeks old, i.e. after they are able to consume calf starter 0.5-0.68 kg/day, but at this age weaning has a high risk of calf death so that calves are generally weaned at 3 months of age (NRC, 2001; Prihantoro et al., 2012). When weaning, the calf enters the initial phase of growth, so most of the nutrients consumed will be used for growth such as enlargement of the body skeleton (Imran et al., 2012; Welboren et al., 2019).

The body dimensions of the female calf when weaning are very important because the female calf which from the start already has the ideal body dimensions, will also be an ideal breeder. In addition to body weight gain, the increase in body dimensions (heart girt, withers height, body length) in weaning calves is also a measure of the calf's appearance or performance (Hardiono et al., 2016; Rotondo et al., 2021). The calf when post-weaning should have a heart girt of 96 cm and a withers height of 75 cm so that later it can meet the target of a heart girt of 155 cm and withers height of 115 cm at the time of entering the age of 15 months for first mating (Alim and Hidaka, 2002). The formation of body dimensions is influenced by the adequacy of nutrient needs. Weaning calves are usually fed high-quality forage and concentrates formulated to meet nutritional needs and increase body weight (ASAS, 2020).

However, in practice in the field, the provision of feed for post-weaning female calves has not been well considered by small farmers. Generally, smallholder farms provide lactation cow concentrates to calves with the consideration of cheaper concentrate prices. At least lactation cow concentrate has a crude protein CP content is 16-21% and TDN of 70-80% (BSN, 2017). Whereas the nutritional needs of female calves from post-weaning to heifers are different from those of adult cattle, so calves need to be given different feeds from adult cows.

The substitution of calf starter in lactation cow concentrate was carried out with the aim of improving the nutritional quality of the concentrate feed given to weaning calves. Calf starter is different from lactation cow concentrate both physically and in quality (Mukodiningsih et al., 2012). Post-Weaning calves that receive higher-quality feed will produce better performance in body dimensions as well. Larger body weight and body dimensions at the same age indicate better growth (Turiello et al., 2016; Nemati et al., 2016).

This study aimed to determine and examine the increase in body dimensions of post-weaned female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of substitution of calf starter.

## MATERIAL AND METHOD

### Materials

The materials used were 4 post-weaning female Holstein Friesian (HF) calves aged 4-5 months with an average weight of 101.38±14.21 kg. The calves were kept in metabolic cages for the duration of the study. 300 cm long measuring tape with 0.1 cm accuracy and a 1.5 m stainless steel measuring stick with 0.1 cm accuracy were used to measure the body dimensions of livestock. The feed used was elephant grass (*Pennisetum purpureum)*, lactation cow concentrate (LCC), and calf starter (CS) produced by Teaching Farm FPP Undip.

### Methods

The feed provided was forage and concentrate treatment which was adjusted to the dry matter (DM) needs of the calves. Treatment concentrate (in DM) was given as much as 1% body weight (BW) in two doses, i.e. in the morning at 06.00 and in the afternoon at 15.00. Forage and drinking water are provided on a measured ad libitum basis. The forage was given one hour after the concentrate was given. The treatment concentrates consisted of P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), and P4 (100% LCC). The nutritional content of the feed given is shown in Table 1. The research design used was the Latin Square Design (LSD) with 4 treatments and 4 periods.

Feeding and residues of feed and drinking water to livestock were recorded in a logbook on a regular basis. The study was conducted in 4 periods, each period was carried out for 30 days of observation. The parameters measured were heart girth (HG), body length (BL), and withers height (WH). Measurement of body dimensions was carried out at the beginning and end of the period based on Welboren et al. (2019) and Lardy et al. (2020), followed by a break for 5 days and continued to the next period.

### Statistical Analyses

All data were analyzed using analysis of variance (ANOVA) based on the Latin Square Design. If there was a treatment effect, then Duncan's test was continued to determine the difference between treatments.

Table 1. Nutrient content of feed

| Feed | Water | Ash | EE | CF | CP | NFE | TDN |
|---|---|---|---|---|---|---|---|
| | --(%)-- | | ---------- (% DM) ---------- | | | | |
| Lactation Cow Concentrate (LCC) | 9,42 | 9,90 | 6,42 | 26,87 | 16,40 | 40,41 | 64,91 |
| Calf Starter (CS) | 11,17 | 12,32 | 5,25 | 8,74 | 19,70 | 53,99 | 76,13 |
| Elephant Grass | 78,08 | 13,31 | 2,17 | 28,64 | 12,13 | 43,75 | 58,5 |
| P1 | 10,73 | 11,71 | 5,54 | 13,27 | 18,87 | 50,61 | 73,32 |
| P2 | 10,29 | 11,11 | 5,83 | 17,80 | 18,05 | 47,21 | 70,52 |
| P3 | 9,86 | 10,50 | 6,13 | 22,33 | 17,25 | 43,79 | 67,71 |
| P4 | 9,42 | 9,90 | 6,42 | 26,87 | 16,40 | 40,41 | 64,91 |

Note: EE = ether extract, CF = crude fiber, CP = crude protein, NFE = nitrogen free extract, TDN = total digestible nutrients, DM = dry matter, P1 (75% calf starter and 25% LCC), P2 (50% calf starter and 50% lactation cow concentrate), P3 (25% calf starter and 75% lactation cow concentrate), and P4 (100% lactation cow concentrate)

## RESULTS AND DISCUSSION

The results of the study on the effect of substitution of calf starter on lactating cow concentrate on body dimensions increase in post-weaning HF female calves are presented in Table 2. Treatment of calf starter substitution on lactating cow concentrate (P1, P2, P3, and P4) had no significant effect ($p>0$ 0.05) on the average body size at the end of the study and the increase in body dimensions of livestock which includes heart girth, body length, and withers height. These results have the same phenomenon as the research of Purwadi (2017) that giving concentrates with different protein content, i.e. 10.23% and 13.79% in post-weaning female calves aged 3.5 months gave no significant effect on body dimensions increase.

The increase in body size that did not differ between treatments could be caused by the relatively same amount of daily consumption so that the nutrients digested by the calves were also the same. The average DM consumption was also not significantly different, i.e. P1 3.43 kg/day, P2 3.54 kg/day, P3 3.58 kg/day and P4 3.34 kg/day. The substitution of calf starter was intended to make the nutritional content of concentrate feed for post-weaning calves better at smallholder farms when compared to feed from lactation cow concentrate alone. Forage feed was given in a measurable ad libitum with the aim of the calves being able to meet the nutritional deficiencies from the consumption of concentrates by obtaining them from forage consumption. However, giving a concentrate that was 1% of body weight or with a forage: concentrate balance of 70:30 in this study, it was assumed that if the consumption of DM was relatively the same, the consumption of other nutrients was relatively the same as well. Nutrients from the feed digestion process in the form of energy, protein, fat, minerals, and so on will be used by the calf to meet the nutritional needs for calf growth. Imran et al. (2012) stated that the nutrients digested by the calf will be used to meet the needs to support the growth of the calf according to its genetics. Research by Kargar et al. (2019) also shows the body dimensions of post-weaning calves that were not different because the amount of DM consumption and the nutritional content consumed were relatively the same. According to Winarti and Widyastuti (2016), almost the same DM consumption will result in calf growth between treatments, there was no difference because the consumption of nutrients was almost the same, both from consumption of crude protein, crude fat (ether extract) and crude fiber.

The growth of the post-weaning calves is indicated by the increase in body dimensions. Calf body dimensions were strongly influenced by feeding, feed consumption and digestibility. The results of this study showed that the increase in body dimensions of post-weaning calves between treatments was relatively the same. This was presumably because during post-weaning the rumen conditions and functions have developed perfectly, so that the results of fermentative digestion of feed in the rumen that can be used for the growth of the post-weaning calves in each treatment were relatively the same, resulting in relatively the same body dimensions even though the calf starter has the better quality than lactation dairy cow concentrate. This can be caused by the condition of the rumen in post-weaning calves that are ready to digest solid feed. McCurdy et al. (2019) stated that when the calf has been weaned, the calf rumen is ready to digest solid feed and the rumen becomes much more sensitive to food fermentability. Rumen microbes were thought to have been able to ferment concentrates and forage well, so that sufficient microbial protein was available for post-weaning calves at P1, P2, P3 and P4. Pramita et al. (2016) stated that rumen microbes are the main source of protein for the host, besides that rumen microbes play an important role in digesting feed because they can produce enzymes that can digest fiber in low-quality feed.

The rumen of the post-weaning calves had a fairly complete set of microorganisms. Xiao et al. (2016) stated that in the rumen of the calf there are fungi, protozoa, and bacteria which include fiber-digesting bacteria such as *Fibrobacter succinogenes*, *Ruminococcus albus*, and *Ruminococcus flavefaciens*, as well as other bacteria such as *Prevotella*, *Butyrivibrio fibrisolvens*, *Shuttleworthia*, and *Desulfovibrio*. In addition, there are two groups of protozoa that are abundant in the rumen, i.e. entodiniomorphid (oligotrich) and holotrich (Yanuartono et al., 2019). With a ready-made rumen condition, post-weaning calves are able to properly utilize forage and concentrates to meet their nutritional needs. This resulted in the administration of lactation cow concentrate with a CP content of 16.40% and TDN of 64.91% (P4), which resulted in an increase in body dimensions that was relatively the same as the concentrate substituted of calf starter (P1, P2, P3) if accompanied by the administration of optimal forage. In this study, post-weaning female HF calves received concentrate as much as 1% of BW and forage given ad libitum.

Table 2. Average body dimensions of post-weaning female HF calves

| Variables | Treatments | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| Initial Body Dimensions (cm) | | | | |
| Heart Girth | 116,92±8,45 | 115,25 ±13,58 | 114,55 ±9,84 | 115,40 ±6,30 |
| Body Length | 96,33 ±8,68 | 97,27 ±10,82 | 98,95 ±7,93 | 99,25 ±3,30 |
| Withers Height | 70,40 ±4,62 | 70,92 ±4,83 | 71,50 ±3,76 | 71,20 ±2,48 |
| Final Body Dimensions (cm) | | | | |
| Heart Girth | 119,23 ±7,82 | 119,48 ±12,25 | 119,15 ±7,46 | 119,50 ±6,46 |
| Body Length | 101,08 ±7,89 | 101,65 ±9,72 | 103,33 ±7,67 | 102,73 ±4,22 |
| Withers Height | 72,35 ±3,92 | 73,15 ±3,67 | 73,85 ±3,23 | 73,38 ±1,60 |
| Increase in Body Dimensions (cm/month) | | | | |
| Heart Girth | 2,31 ±1,36 | 4,23 ±1,85 | 4,60 ±2,81 | 4,10 ±1,13 |
| Body Length | 4,75 ±3,10 | 4,38 ±1,80 | 4,38 ±1,41 | 3,48 ±1,83 |
| Withers Height | 1,95 ±1,08 | 2,23 ±1,58 | 2,35 ±2,16 | 2,18 ±1,48 |

Note: P1 (75% calf starter and 25% LCC), P2 (50% calf starter and 50% lactation cow concentrate), P3 (25% calf starter and 75% lactation cow concentrate), and P4 (100% lactation cow concentrate)

**Increase in Heart Girth (HG)**

The increase in heart girth of calves treated with calf starter substitution on lactation cow concentrates was 2.31±1.36 cm/month (P1), 4.23±1.85 cm/month (P2), 4.60±2.81 cm/month (P3), and 4.10±1.13 cm/month (P4). These results were lower than the study results of Manthey et al. (2016) with the addition of DDGS treatment in concentrates with different concentrations in Holstein's calves, i.e. an average of 5.22 cm/month, also the results of research by Wang et al. (2017) who gave a concentrate with a different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 5.36 cm/month. Differences in the results of these studies can be caused by genetic influences, environmental climate, feed given, and maintenance management. This is in accordance with the statement of Ratnasari et al. (2019) that differences in growth in livestock can be caused by climate, the genetic capabilities of each animal, maintenance, and feed management.

Giving calf starter substitution in lactation cow concentrate had no effect on the increase in heart girth of post-weaning female HF calves ($p>0.05$). This condition may occur because the nutrition from the feed consumed by the calf has been used for bone growth, organ growth, and meat growth. This was in accordance with the opinion of Parsons et al. (2020) who stated that body size is closely related to body weight which is influenced by bone growth and then fat deposition. The growth of meat and bones affects the size of the heart girth, chest width, abdominal girth, and body weight of livestock, while bone growth affects body length, withers height, and body weight of livestock. The increase in the size of the heart girth occurs because the heart girth is closely related to the body weight of the cattle, so when the weight of the cattle increases, the heart girth will be even bigger, including HF calves (Sulistyowati et al., 2009; Hardiono et al., 2016; Rotondo et al., 2021). Syaiful et al. (2020) stated that the bigger the heart girth, the bigger the organs in the chest cavity such as the heart and lungs, therefore heart girth can be used as an indicator of the calf body capacity.

**Increase in Body Length (BL)**

Giving calf starter substitution to lactation cow concentrate had no effect on the increase in body length for post-weaning female HF calves ($p>0.05$). The results of each treatment were 4.75±3.10 cm/month (P1), 4.38±1.80 cm/month (P2), 4.38±1.41 cm/month (P3) and 3.48±1.83 cm/month (P4). This result was higher than the average result of Anderson et al. (2015) in the treatment of concentrates from grains with different fat and protein content in Holstein calves, which was an average of 3.93 cm/month, but lower than the average results of Wang et al. (2017) on concentrate treatment with different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 6.15 cm/month. The results of these studies differ because they are caused by several factors, i.e. livestock age, genetics, feed quality, and maintenance management (Vavrisinova et al., 2019).

The size of the calf's body length did not differ, this was a result of the treatment with calf starter substitution on lactation cow concentrate, which could be due to genetic influences and almost the same age. This is in accordance with the research results of Senevirathne et al. (2016) that there was no difference between treatments for calf body dimensions, indicating that calves were in the

same period so that the growth rate of their body skeletons did not differ. At the time the research was carried out, the calf was in the growth acceleration phase so that the feed consumed by the calf would be used maximally for the growth of its body frame. Putra and Fajrina (2020) stated that the maximum growth rate occurs when the calf is 4-8 months old. This was reinforced by the opinion of Nugraha et al. (2016) who stated that livestock growth is influenced by the feed given, if the feed provided is of good quality and in sufficient quantity, then livestock growth will also be good.

**Increase in Withers Height (WH)**

Giving calf starter substitution to lactation cow concentrate did not have a different effect on the increase in withers height of post-weaning female HF calves ($p>0.05$). The treatment concentrate gave an increase in the size of the wither's height by 1.95±1.08 cm/month (P1); 2.23±1.58 cm/month (P2); 2.35±2.16 cm/month (P3) and 2.18±1.48 cm/month (P4). This result was lower than the results of the study by Manthey and Anderson (2018) by giving corn and soybean-based concentrates (with ad libitum forage) to Holstein's calves which resulted in an average increase in withers height of 3.03 cm/month. Differences in the results of this study can be influenced by factors such as the age of livestock, environmental climate, feed given, and maintenance management (Place & Mitloehner, 2010).

The results of the increase in wither height which did not differ from all treatments with calf starter substitution in lactation cow concentrate were also due to the age of the calf which was in the early stages of growth so that the nutrients from the feed consumed were used for bone growth, including the forefoot bones that greatly affect the value of withers height. This was in accordance with the opinion of Syaiful et al. (2020) which stated that at the age of 0-6 months the calf experiences faster growth in its forelegs because the forelegs are used to actively move when the calf is suckling on its mother, in addition, the forelegs are used to support the calf body weight. The increase in wither height is closely related to the growth of the calf's skeletal bones. This was in accordance with the opinion of Maluhima et al. (2019) who stated that withers height is influenced by several factors, including feeding management, genetics, the condition of the livestock itself, and having a close relationship with the size of the calf frame.

## CONCLUSION

The substitution of calf starter on lactation cow concentrate did not have a different effect on the increase in body dimensions (heart girth, body length, withers height) of post-weaning female HF calves. Lactation cow concentrate with PK 16.40% and TDN 64.91% followed by good quality forage in sufficient quantities was able to meet the nutritional needs of weaning calves seen from the performance of increasing body dimensions.

## CONFLICT OF INTEREST

There is no conflict of interest with financial, personal, or other relationship with other people or organizations associated with material discussed in the manuscript.

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# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

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# Increase in Body Dimensions of Post-Weaning Female Holstein Friesian Calves Due to the Use of Lactation Cow Concentrate by Calf Starter Substitution

**Rudy Hartanto*, Nida Fariha, Dian Wahyu Harjanti, Edi Prayitno, Fajar Wahyono**

Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Tembalang Campus, Semarang City, Central Java, 50275

*Corresponding author: rudyharta@gmail.com

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## ABSTRACT

The aim of the study was to analyze the increase in body dimensions of post-weaning female Holstein Friesian (HF) calves fed with lactation cow concentrate with different levels of calf starter substitution. The material was 4 post-weaning female HF calves aged 4-5 months, with an average weight of 101.38 ± 14.21 kg. The feed consisted of elephant grass, calf starter (CS), and lactation cow concentrate (LCC). The study used a Latin square design, with 4 concentrate treatments, i.e. P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), P4 (100% LCC); and 4 replications in 4 periods (each period in 1 month). The concentrate was given 1% BW in the dry matter; elephant grass and drinking water were provided in a measurable ad libitum. The research parameters were the increase in body dimensions (heart girth (HG), body length (BL), and withers height (WH)). The treatments had no significant effect ($p>0.05$) on the increase in body dimensions, were P1 (HG = 2.31 cm/month, BL = 4.75 cm/month, WH = 1.95 cm/month), P2 (HG = 4.23 cm/month, BL = 4.38 cm/month, WH = 2.23 cm/month), P3 (HG = 4.60 cm/month, BL = 4.38 cm/month, WH = 2.35 cm/month), P4 (HG = 4,10 cm/month, BL = 3.48 cm/month, WH = 2.18 cm/month). It was concluded that with sufficient quality forage feed, giving 100% LCC to post-weaning female HF calves could result in an increase in body dimensions that was relatively the same as the substitution of CS (25-75%) in LCC as concentrate feed.

**Keywords:** post-weaning female HF calves, body dimensions, calf starter, lactation cow concentrate

## INTRODUCTION

Feeding and drinking as well as calf health are important factors that need to be considered in order to get good calf growth, both pre-weaning and after-weaning. Calves that have been weaned do not get milk and fulfill their nutritional needs in full from forages and concentrates (Kusumawati et al., 2018; Atabany et al., 2020). Calves can be weaned when they are 8 weeks old, i.e. after they are able to consume calf starter 0.5-0.68 kg/day, but at this age weaning has a high risk of calf death so that calves are generally weaned at 3 months of age (NRC, 2001; Prihantoro et al., 2012). When weaning, the calf enters the initial phase of growth, so most of the nutrients consumed will be used for growth such as enlargement of the body skeleton (Imran et al., 2012; Welboren et al., 2019).

The body dimensions of the female calf when weaning are very important because the female calf which from the start already has the ideal body dimensions, will also be an ideal breeder. In addition to body weight gain, the increase in body dimensions (heart girt, withers height, body length) in weaning calves is also a measure of the calf's appearance or performance (Hardiono et al., 2016; Rotondo et al., 2021). The calf when post-weaning should have a heart girt of 96 cm and a withers height of 75 cm so that later it can meet the target of a heart girt of 155 cm and withers height of 115 cm at the time of entering the age of 15 months for first mating (Alim and Hidaka, 2002). The formation of body dimensions is influenced by the adequacy of nutrient needs. Weaning calves are usually fed high-quality forage and concentrates formulated to meet nutritional needs and increase body weight (ASAS, 2020).

However, in practice in the field, the provision of feed for post-weaning female calves has not been well considered by small farmers. Generally, smallholder farms provide lactation cow concentrates to calves with the consideration of cheaper concentrate prices. At least lactation cow concentrate has a crude protein CP content is 16-21% and TDN of 70-80% (BSN, 2017). Whereas the nutritional needs of female calves from post-weaning to heifers are different from those of adult cattle, so calves need to be given different feeds from adult cows.

The substitution of calf starter in lactation cow concentrate was carried out with the aim of improving the nutritional quality of the concentrate feed given to weaning calves. Calf starter is different from lactation cow concentrate both physically and in quality (Mukodiningsih et al., 2012). Post-Weaning calves that receive higher-quality feed will produce better performance in body dimensions as well. Larger body weight and body dimensions at the same age indicate better growth (Turiello et al., 2016; Nemati et al., 2016).

This study aimed to determine and examine the increase in body dimensions of post-weaned female Holstein Friesian (HF) calves fed with dairy cow concentrate with different levels of substitution of calf starter.

## MATERIAL AND METHOD

### Materials

The materials used were 4 post-weaning female Holstein Friesian (HF) calves aged 4-5 months with an average weight of 101.38±14.21 kg. The calves were kept in metabolic cages for the duration of the study. 300 cm long measuring tape with 0.1 cm accuracy and a 1.5 m stainless steel measuring stick with 0.1 cm accuracy were used to measure the body dimensions of livestock. The feed used was elephant grass (*Pennisetum purpureum)*, lactation cow concentrate (LCC), and calf starter (CS) produced by Teaching Farm FPP Undip.

### Methods

The feed provided was forage and concentrate treatment which was adjusted to the dry matter (DM) needs of the calves. Treatment concentrate (in DM) was given as much as 1% body weight (BW) in two doses, i.e. in the morning at 06.00 and in the afternoon at 15.00. Forage and drinking water are provided on a measured ad libitum basis. The forage was given one hour after the concentrate was given. The treatment concentrates consisted of P1 (75% CS and 25% LCC), P2 (50% CS and 50% LCC), P3 (25% CS and 75% LCC), and P4 (100% LCC). The nutritional content of the feed given is shown in Table 1. The research design used was the Latin Square Design (LSD) with 4 treatments and 4 periods.

Feeding and residues of feed and drinking water to livestock were recorded in a logbook on a regular basis. The study was conducted in 4 periods, each period was carried out for 30 days of observation. The parameters measured were heart girth (HG), body length (BL), and withers height (WH). Measurement of body dimensions was carried out at the beginning and end of the period based on Welboren et al. (2019) and Lardy et al. (2020), followed by a break for 5 days and continued to the next period.

### Statistical Analyses

All data were analyzed using analysis of variance (ANOVA) based on the Latin Square Design. If there was a treatment effect, then Duncan's test was continued to determine the difference between treatments.

Table 1. Nutrient content of feed

| Feed | Water | Ash | EE | CF | CP | NFE | TDN |
|---|---|---|---|---|---|---|---|
| | --(%)-- | | ---------- (% DM) ---------- | | | | |
| Lactation Cow Concentrate (LCC) | 9.42 | 9.90 | 6.42 | 26.87 | 16.40 | 40.41 | 64.91 |
| Calf Starter (CS) | 11.17 | 12.32 | 5.25 | 8.74 | 19.70 | 53.99 | 76.13 |
| Elephant Grass | 78.08 | 13.31 | 2.17 | 28.64 | 12.13 | 43.75 | 58.5 |
| P1 | 10.73 | 11.71 | 5.54 | 13.27 | 18.87 | 50.61 | 73.32 |
| P2 | 10.29 | 11.11 | 5.83 | 17.80 | 18.05 | 47.21 | 70.52 |
| P3 | 9.86 | 10.50 | 6.13 | 22.33 | 17.25 | 43.79 | 67.71 |
| P4 | 9.42 | 9.90 | 6.42 | 26.87 | 16.40 | 40.41 | 64.91 |

Note: EE = ether extract, CF = crude fiber, CP = crude protein, NFE = nitrogen free extract, TDN = total digestible nutrients, DM = dry matter

## RESULTS AND DISCUSSION

The results of the study on the effect of substitution of calf starter on lactating cow concentrate on body dimensions increase in post-weaning HF female calves are presented in Table 2. Treatment of calf starter substitution on lactating cow concentrate (P1, P2, P3, and P4) had no significant effect ($p>0$ 0.05) on the average body size at the end of the study and the increase in body dimensions of livestock which includes heart girth, body length, and withers height. These results have the same phenomenon as the research of Purwadi (2017) that giving concentrates with different protein content, i.e. 10.23% and 13.79% in post-weaning female calves aged 3.5 months gave no significant effect on body dimensions increase.

The increase in body size that did not differ between treatments could be caused by the relatively same amount of daily consumption so that the nutrients digested by the calves were also the same. The average DM consumption was also not significantly different, i.e. P1 3.43 kg/day, P2 3.54 kg/day, P3 3.58 kg/day and P4 3.34 kg/day. The substitution of calf starter was intended to make the nutritional content of concentrate feed for post-weaning calves better at smallholder farms when compared to feed from lactation cow concentrate alone. Forage feed was given in a measurable ad libitum with the aim of the calves being able to meet the nutritional deficiencies from the consumption of concentrates by obtaining them from forage consumption. However, giving a concentrate that was 1% of body weight or with a forage: concentrate balance of 70:30 in this study, it was assumed that if the consumption of DM was relatively the same, the consumption of other nutrients was relatively the same as well. Nutrients from the feed digestion process in the form of energy, protein, fat, minerals, and so on will be used by the calf to meet the nutritional needs for calf growth. Imran et al. (2012) stated that the nutrients digested by the calf will be used to meet the needs to support the growth of the calf according to its genetics. Research by Kargar et al. (2019) also shows the body dimensions of post-weaning calves that were not different because the amount of DM consumption and the nutritional content consumed were relatively the same. According to Winarti and Widyastuti (2016), almost the same DM consumption will result in calf growth between treatments, there was no difference because the consumption of nutrients was almost the same, both from consumption of crude protein, crude fat (ether extract) and crude fiber.

The growth of the post-weaning calves is indicated by the increase in body dimensions. Calf body dimensions were strongly influenced by feeding, feed consumption and digestibility. The results of this study showed that the increase in body dimensions of post-weaning calves between treatments was relatively the same. This was presumably because during post-weaning the rumen conditions and functions have developed perfectly, so that the results of fermentative digestion of feed in the rumen that can be used for the growth of the post-weaning calves in each treatment were relatively the same, resulting in relatively the same body dimensions even though the calf starter has the better quality than lactation dairy cow concentrate. This can be caused by the condition of the rumen in post-weaning calves that are ready to digest solid feed. McCurdy et al. (2019) stated that when the calf has been weaned, the calf rumen is ready to digest solid feed and the rumen becomes much more sensitive to food fermentability. Rumen microbes were thought to have been able to ferment concentrates and forage well, so that sufficient microbial protein was available for post-weaning calves at P1, P2, P3 and P4. Pramita et al. (2016) stated that rumen microbes are the main source of protein for the host, besides that rumen microbes play an important role in digesting feed because they can produce enzymes that can digest fiber in low-quality feed.

The rumen of the post-weaning calves had a fairly complete set of microorganisms. Xiao et al. (2016) stated that in the rumen of the calf there are fungi, protozoa, and bacteria which include fiber-digesting bacteria such as *Fibrobacter succinogenes*, *Ruminococcus albus*, and *Ruminococcus flavefaciens*, as well as other bacteria such as Prevotella, Butyrivibrio fibrisolvens, Shuttleworthia, and Desulfovibrio. In addition, there are two groups of protozoa that are abundant in the rumen, i.e. entodiniomorphid (oligotrich) and holotrich (Yanuartono et al., 2019). With a ready-made rumen condition, post-weaning calves are able to properly utilize forage and concentrates to meet their nutritional needs. This resulted in the administration of lactation cow concentrate with a CP content of 16.40% and TDN of 64.91% (P4), which resulted in an increase in body dimensions that was relatively the same as the concentrate substituted of calf starter (P1, P2, P3) if accompanied by the administration of optimal forage. In this study, post-weaning female HF calves received concentrate as much as 1% of BW and forage given ad libitum.

Table 2. Average body dimensions of post-weaning female HF calves

| Variables | Treatments | | | |
|---|---|---|---|---|
| | P1 | P2 | P3 | P4 |
| Initial Body Dimensions (cm) | | | | |
| Heart Girth | 116.92±8.45 | 115.25 ±13.58 | 114.55 ±9.84 | 115.40 ±6.30 |
| Body Length | 96.33 ±8.68 | 97.27 ±10.82 | 98.95 ±7.93 | 99.25 ±3.30 |
| Withers Height | 70.40 ±4.62 | 70.92 ±4.83 | 71.50 ±3.76 | 71.20 ±2.48 |
| Final Body Dimensions (cm) | | | | |
| Heart Girth | 119.23 ±7.82 | 119.48 ±12.25 | 119.15 ±7.46 | 119.50 ±6.46 |
| Body Length | 101.08 ±7.89 | 101.65 ±9.72 | 103.33 ±7.67 | 102.73 ±4.22 |
| Withers Height | 72.35 ±3.92 | 73.15 ±3.67 | 73.85 ±3.23 | 73.38 ±1.60 |
| Increase in Body Dimensions (cm/month) | | | | |
| Heart Girth | 2.31 ±1.36 | 4.23 ±1.85 | 4.60 ±2.81 | 4.10 ±1.13 |
| Body Length | 4.75 ±3.10 | 4.38 ±1.80 | 4.38 ±1.41 | 3.48 ±1.83 |
| Withers Height | 1.95 ±1.08 | 2.23 ±1.58 | 2.35 ±2.16 | 2.18 ±1.48 |

**Increase in Heart Girth (HG)**

The increase in heart girth of calves treated with calf starter substitution on lactation cow concentrates was 2.31±1.36 cm/month (P1), 4.23±1.85 cm/month (P2), 4.60±2.81 cm/month (P3), and 4.10±1.13 cm/month (P4). These results were lower than the study results of Manthey et al. (2016) with the addition of DDGS treatment in concentrates with different concentrations in Holstein's calves, i.e. an average of 5.22 cm/month, also the results of research by Wang et al. (2017) who gave a concentrate with a different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 5.36 cm/month. Differences in the results of these studies can be caused by genetic influences, environmental climate, feed given, and maintenance management. This is in accordance with the statement of Ratnasari et al. (2019) that differences in growth in livestock can be caused by climate, the genetic capabilities of each animal, maintenance, and feed management.

Giving calf starter substitution in lactation cow concentrate had no effect on the increase in heart girth of post-weaning female HF calves ($p>0.05$). This condition may occur because the nutrition from the feed consumed by the calf has been used for bone growth, organ growth, and meat growth. This was in accordance with the opinion of Parsons et al. (2020) who stated that body size is closely related to body weight which is influenced by bone growth and then fat deposition. The growth of meat and bones affects the size of the heart girth, chest width, abdominal girth, and body weight of livestock, while bone growth affects body length, withers height, and body weight of livestock. The increase in the size of the heart girth occurs because the heart girth is closely related to the body weight of the cattle, so when the weight of the cattle increases, the heart girth will be even bigger, including in HF calves (Sulistyowati et al., 2009; Hardiono et al., 2016; Rotondo et al., 2021). Syaiful et al. (2020) stated that the bigger the heart girth, the bigger the organs in the chest cavity such as the heart and lungs, therefore heart girth can be used as an indicator of the calf body capacity.

**Increase in Body Length (BL)**

Giving calf starter substitution to lactation cow concentrate had no effect on the increase in body length for post-weaning female HF calves ($p>0.05$). The results of each treatment were 4.75±3.10 cm/month (P1), 4.38±1.80 cm/month (P2), 4.38±1.41 cm/month (P3) and 3.48±1.83 cm/month (P4). This result was higher than the average result of Anderson et al. (2015) in the treatment of concentrates from grains with different fat and protein content in Holstein calves, which was an average of 3.93 cm/month, but lower than the average results of Wang et al. (2017) on concentrate treatment with different physically effective neutral detergent fiber (peNDF) content in Holstein's calves, i.e. 6.15 cm/month. The results of these studies differ because they are caused by several factors, i.e. livestock age, genetics, feed quality, and maintenance management (Vavrisinova et al., 2019).

The size of the calf's body length did not differ, this was a result of the treatment with calf starter substitution on lactation cow concentrate, which could be due to genetic influences and almost the same age. This is in accordance with the research results of Senevirathne et al. (2016) that there was no difference between treatments for calf body dimensions, indicating that calves were in the same period so that the growth rate of their body skeletons did not differ. At the time the research was carried out, the calf was in the growth

acceleration phase so that the feed consumed by the calf would be used maximally for the growth of its body frame. Putra and Fajrina (2020) stated that the maximum growth rate occurs when the calf is 4-8 months old. This was reinforced by the opinion of Nugraha et al. (2016) who stated that livestock growth is influenced by the feed given, if the feed provided is of good quality and in sufficient quantity, then livestock growth will also be good.

**Increase in Withers Height (WH)**

Giving calf starter substitution to lactation cow concentrate did not have a different effect on the increase in withers height of post-weaning female HF calves ($p>0.05$). The treatment concentrate gave an increase in the size of the wither's height by 1.95±1.08 cm/month (P1); 2.23±1.58 cm/month (P2); 2.35±2.16 cm/month (P3) and 2.18±1.48 cm/month (P4). This result was lower than the results of the study by Manthey and Anderson (2018) by giving corn and soybean-based concentrates (with ad libitum forage) to Holstein's calves which resulted in an average increase in withers height of 3.03 cm/month. Differences in the results of this study can be influenced by factors such as the age of livestock, environmental climate, feed given, and maintenance management (Place & Mitloehner, 2010).

The results of the increase in wither height which did not differ from all treatments with calf starter substitution in lactation cow concentrate were also due to the age of the calf which was in the early stages of growth so that the nutrients from the feed consumed were used for bone growth, including the forefoot bones that greatly affect the value of withers height. This was in accordance with the opinion of Syaiful et al. (2020) which stated that at the age of 0-6 months the calf experiences faster growth in its forelegs because the forelegs are used to actively move when the calf is suckling on its mother, in addition, the forelegs are used to support the calf body weight. The increase in wither height is closely related to the growth of the calf's skeletal bones. This was in accordance with the opinion of Maluhima et al. (2019) who stated that withers height is influenced by several factors, including feeding management, genetics, the condition of the livestock itself, and having a close relationship with the size of the calf frame.

## CONCLUSION

The substitution of calf starter on lactation cow concentrate did not have a different effect on the increase in body dimensions (heart girth, body length, withers height) of post-weaning female HF calves. Lactation cow concentrate with PK 16.40% and TDN 64.91% followed by good quality forage in sufficient quantities was able to meet the nutritional needs of weaning calves seen from the performance of increasing body dimensions.

## CONFLICT OF INTEREST

There is no conflict of interest with financial, personal, or other relationship with other people or organizations associated with material discussed in the manuscript.

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