ผลของการใช้มันเส้นเพื่อเป็นแหล่งคาร์โบไฮเดรทที่ไม่เป็นโครงสร้าง สำหรับโคระยะรีดนมที่ได้รับฟางหมักยูเรียเป็นแหล่งอาหารหยาบ

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บทคัดย่อ

การศึกษาในครั้งนี้ใช้โคนมพันธุ์โฮลสไตน์ จำนวน 24 ตัว อยู่ในช่วงแรก (35-75 วัน) และช่วงกลาง (76-120 วัน) ของการรีดนม โคมีน้ำหนักเฉลี่ย 383 ± 12 กก. ใช้แผนการทดลองแบบ Randomized complete block design (RCBD) โดยใช้วันของการรีดนมเป็น block เพื่อให้โคได้รับอาหารทดลองจำนวน 4 กลุ่ม ได้แก่ อาหารข้นที่ประกอบด้วยมันเส้นร้อยละ 15, 30, 45 และ 60 ตามลำดับ ซึ่งระดับมันเส้นที่สูงขึ้นใช้ทดแทนรำข้าว อาหารหยาบที่ใช้คือฟางหมักยูเรีย โดยโคได้รับอาหารหยาบต่ออาหารข้นในสัดส่วนร้อยละ 40 : 60

ผลการทดลองพบว่า ปริมาณการกินได้เพิ่มขึ้นตามระดับมันเส้นที่เพิ่มขึ้นในอาหารข้นจนสูงสุดเมื่อโคได้รับสูตรที่มีมันเส้นร้อยละ 45 และลดลง ($p<0.05$) เมื่อโคได้รับอาหารข้นสูตรที่มีมันเส้นร้อย 60 ในขณะที่ปริมาณการกินได้ของคาร์โบไฮเดรทที่ไม่เป็นโครงสร้าง เพิ่มทั้งแบบเส้นตรง (linearly, $p< 0.001$) และแบบเส้นโค้ง (quadratically, $p<0.001$) ส่วนปริมาณการกินโภชนะที่ย่อยได้ ผลผลิตและองค์ประกอบน้ำนม (ไขมัน, โปรตีน, ของแข็งที่ไม่ใช่ไขมัน และของแข็งทั้งหมด) เพิ่มขึ้นแบบเส้นโค้ง ($p<0.01$) และลดลง ($p<0.05$) เมื่อโคได้รับอาหารสูตรที่มีมันเส้นร้อยละ 60 จากการศึกษาในครั้งนี้สรุปได้ว่าระดับมันเส้นในอาหารข้นของโคนมช่วงแรกและช่วงกลางของการรีดนม และได้รับฟางหมักยูเรียเป็นอาหารหยาบ อยู่ในช่วงร้อยละ 30-45 หรือประกอบด้วยคาร์โบไฮเดรทที่ไม่เป็นโครงสร้างอยู่ในช่วงร้อยละ 32.2 – 35.6 ตามลำดับ

คำสำคัญ : มันเส้น / โคนม / คาร์โบไฮเดรทที่ไม่เป็นโครงสร้าง / ฟางหมักยูเรีย

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Effects of Cassava Chips used as Non-structural Carbohydrate Source for Lactating Dairy Cows Fed Urea-treated Rice Straw

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Abstract

Twenty-four multiparous Holstein cows in early and mid-lactation, an average weight of 382 ± 12 kg and were blocked according to days in milk (DIM) into two groups (30 - 75 DIM and 76 - 120 DIM). All cows within each group were randomly allocated to one of the four experimental diets accordingly to a randomized completed block design (RCBD) with six replications per treatments. The dietary treatments were concentrate based, containing 15, 30, 45 and 60% of cassava chips (CC) in concentrate (18%CP) replacing rice bran. Cows were offered diets as consisted of 60% concentrate and 40% urea-treated rice straw (UTRS).

Urea-treated rice straw (UTRS) and total dry matter intakes increased ($p<0.001$) with increasing levels of CC in concentrate up to the 45%CC, thereafter both UTRS and total dry matter intakes were significantly decreased ($p<0.001$) where cows fed the 60%CC in concentrate. Total non-structural carbohydrate (NSC) intake increased linearly ($p<0.001$) and quadratically ($p<0.001$) with increasing levels of CC in concentrate (28.9, 32.2, 35.6 and 38.2% of DMI intake). Digestible nutrients intake, milk yield and milk compositions (fat, protein, solid-not fat, total solid) in terms of yield and concentration quadratically ($p<0.01$) increased with increasing levels of CC in concentrate up to the 45%CC, thereafter significantly decreased ($p<0.001$) where cows fed the 60% CC in concentrate. The optimal level of cassava chips in a lactating dairy cow diet is suggested as being between 30 to 45% of cassava chips or 32.2 to 35.6% NSC intake in the concentrate when fed with UTRS as roughage.

Keywords : Cassava Chip / Dairy Cattle / Non-structural Carbohydrate / Urea-treated Rice Straw

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1. Introduction

Cassava or tapioca (*Manihot esculenta* crantz) is widely grown in Thailand especially in northeastern and has been important exporting cash crop in recent years. Cassava chip or pellet was used well in ruminants. The considerable increase in the feed costs when based on imported materials has necessitated a search for cheaper energy sources on farm to replace expensive sources, such as corn or rice bran, in dairy rations. In a previous trial by [1] reported on better of broken rice and cassava chip than those of molasses and corn meal when supplemented in straw based-diets. The result with cassava chip was in agreement of the work earlier carried out by [2-4]. It has also been reported that inclusion of cassava to partly replaces cereal grains (barley, sorghum, corn) with up to 30 to 40% in diets results in satisfactory animal performances and no negative effects on animal health in finishing beef cattle [5-7]. In addition, cow fed grass silage or pasture had shown no effect on milk production in dairy cow when replaced corn/barley by cassava chip [8]. However, the responses to cassava chip, which is highly degradable in the rumen have not been extensively studied in lactating cows when fed low-quality roughages. Therefore, this study was conducted to evaluate the effects of cassava chip inclusion in to the diets based on urea-treated rice straw (UTRS) upon feed intake, digestibility, milk yield and milk compositions.

2. Materials and methods

21. Experimental animals and diets

Twenty-four multiparous Holstien Friesian cow with approximately body weight of 382 ± 12 kg at the beginning of the experiment, were blocked according to days in milk (DIM) into two groups (30-75 days and 76-120 days). There were four experimental diets, all cows were randomly allocated to received experimental diets, respectively accordingly to a randomized completed block design (RCBD) with six replications per treatments.

Experimental diets were formulated according to the nutrient requirement of lactating cows with 400 kg body weight, and producing 17 kg of 4.0% FCM daily [9]. Dietary treatments 1, 2, 3 and 4 were inclusion of 15, 30, 45 and 60% CC in concentrate, respectively. The concentrate dietary treatments were given in Table 1. Cows were fed dietary treatments consisted of urea-treated rice straw (UTRS) *ad libitum* for all treatments and concentrate at ratio 40 to 60, were fed twice daily in equal portions at 07.00 and 18.00. The cows were milked twice daily at 06.00 and 17.00. Experimental diets were offered for 8 wk. Body weight of cows were recorded every 2 wk after the morning milking.

Table 1 Composition of concentrate diets used in the experiment (%)

Ingredients (DM basis)	Cassava chips (CC) levels in concentrate (%)			
	15%CC	30%CC	45%CC	60%CC
Cassava chip	15.0	30.0	45.0	60.0
Dried brewer's grain	10.0	10.0	10.0	10.0
Soybean meal	7.8	7.8	7.8	7.8
Rice bran	50	40	25.4	12.8
Cane molasses	8.9	3.5	3.0	1.0
Urea	2.2	2.5	2.9	3.3
Salt	1.0	1.0	1.0	1.0
Dairy premix	1.1	1.1	1.1	1.1
Dicalcium-phosphate	0.6	0.6	0.6	0.6
Sulphur	0.1	0.1	0.1	0.1
Limstone	0.1	0.1	0.1	0.1
Total	100	100	100	100
Calculated of nutrients				
Crude protein	18.2	18.2	18.2	18.2
Total digestible nutrient (%)	75.7	75.6	75.7	75.5

2.2 Sample collection and analyses

Milk yield was recorded daily at each milking. Milk samples were collected from consecutive morning and afternoon milking. A fresh sample of milk was analyzed daily for fat, protein and total solid (TS) according to AOAC [10-11]. Feed intake was recorded daily. UTRS was sampled for 2 consecutive days and composited prior to analyses. Apparent digestion coefficients were calculated by using equations developed by [12]. Rectal grab samples were taken three times daily at 08.00, 13.00 and 16.00 for two days before the end of the experiment. Fecal samples were kept frozen (-20°C) until analyzed. Composited samples were ground (1 mm screen using Cyclotech Mill, Tecator, Sweden), and then analyzed for dry matter (DM), ash, neutral detergent fiber (NDF), acid detergent fiber (ADF), ether extract (EE), crude protein (CP) contents [10, 13] and acid-insoluble ash (AIA) [14]. AIA was used to estimate digestibility coefficient of nutrients.

Blood samples were collected at 4 h after feeding for two days before the end of the experiment. Samples (10 ml) were collected from the coccygeal vessels into tube containing sodium heparin. Blood was immediately chilled to 4 °C and transported to the laboratory. Samples were centrifuged at 3,000 x g for 15 min at 4 °C; plasma was analyzed plasma urea nitrogen (PUN) [15].

Urine samples from each cow were collected directly from the animal by vulva stimulation technique twice a day at 09.00 and 16.00 for two days before the end of the experiment. A 10 ml sample of urine was acidified with 1 ml 10% H_2SO_4 to maintain pH<2. The samples from each cow were composited a 50:50 basis and frozen for subsequent analyses of urinary purine derivatives using HPLC technique [16].

2.3 Statistical analysis

All data obtained from the experiment were subjected to the General Linear Models procedures the Statistical Analysis Systems Institute [17] according to a RCBD using DIM as block. The following models were used for statistical analysis.

$$Yij = \mu + Co + Bli + Tj + Eij$$

where, Yij = observation in block I (i = 1 - 6) and treatment j (j = 1 - 4)
μ = overall mean
Co = covariant (pre-treatment of milk yield)
Bli = block effect (I = 1 - 6)
Tj = treatment effect (j = 1 - 4)
Eij = residual.

Analysis of covariance was used for the parameters of milk yield. Type III Sums of Squares, which account for missing values in the data, were used to determine whether treatment effects were significant. Least square means are presented a long with predicted differences. Significant difference between treatments are shown at $p<0.05$ unless otherwise noted.

3. Results

3.1 Chemical composition

Table 2 shows the chemical composition of the concentrate, urea-treated rice straw (UTRS) and cassava chips (CC) used in this experiment. Urea-treated rice straw contained 7.8% CP, and 70.2% NDF, while CC contained 2.1% CP, and 9.63% NDF. The DM, CP and EE contents were similar in all dietary treatments. Organic matter and NSC increased slightly with increasing CC levels in concentrate, while NDF slightly decreased with increasing CC levels in concentrate.

3.2 Feed intake, nutrient intake and body weight change

Least square means of feed intake, nutrient intake and body weight changes are given in Table 3. Urea-treated rice straw intake increased quadratically ($p<0.001$) with increasing levels of CC in concentrate up to the 45%CC in concentrate. Similarly, results of total dry matter intake (DMI) in terms of kg, %BW and g/kgBW$^{0.75}$ were increased quadratically ($p<0.001$) with increasing levels of CC in concentrate up to the 45%CC. Total DMI of cows fed 45%CC was significantly higher ($p<0.001$) than those of cows fed 15 and 60%CC in concentrate, and total DMI of cows fed 30%CC was significantly higher ($p<0.001$) than 15%CC and 60%CC, respectively. However, different of total DMI of cows fed 15%CC and 60%CC was not significant.

Table 2 Chemical compositions of concentrate and feed ingredients

Composition	Cassava chip (CC) levels in concentrate (%)				UTRS	CC
	15%CC	30%CC	45%CC	60%CC		
DM (%)	90.5	90.2	89.8	91.1	55.6	89.4
-------------------------- %DM basis --------------------------						
CP	18.3	18.2	18.3	18.3	7.8	2.1
OM	87.0	91.4	94.3	96.8	86.5	91.7
NDF	18.7	17.7	14.2	12.9	70.2	9.6
EE	3.1	3.2	3.2	3.2	1.2	1.0
NSC[1]	46.9	52.3	58.6	62.4	9.3	81.0

DM = dry matter, OM = organic matter, NDF = neutral detergent fiber, ADF = acid detergent fiber, CC = cassava chip, UTRS = urea-treated rice straw, [1]non-structural carbohydrate (NSC) = 100 - (ash + CP + NDF + EE).

Table 3 Least square means for feed intake and body weight change of lactating dairy cows fed concentrated containing different proportions of cassava chip (CC) using urea-treated rice straw (UTRS) as roughage

	Cassava chip (CC) levels in concentrate, %				SE	Contrast*	
	15%CC	30%CC	45%CC	60%CC		L	Q
UTRS intake							
kg	5.3 c	5.7 b	6.0 a	5.2 c	0.07	ns	0.001
%BW	1.4 c	1.5 b	1.6 a	1.4 c	0.02	ns	0.001
g/kgW $^{0.75}$	60.9 c	66.3 b	68.3 a	60.4 c	0.85	ns	0.001
Total intake							
kg	13.5 c	14.3 b	14.9 a	13.6 c	0.12	0.016	0.001
%BW	3.5 c	3.8 b	3.9 a	3.6 c	0.04	ns	0.001
g/kgW $^{0.75}$	156.1 c	165.8 b	172.1 a	157.0 c	1.74	ns	0.001
Nutrient intake (kg DM/ d)							
OM	11.8 c	12.8 b	13.6 a	12.6 c	0.14	0.001	0.001
CP	2.2 b	2.4 a	2.4 a	2.2 b	0.02	ns	0.001
NDF	5.3 c	5.5 b	5.4 a	4.9 d	0.06	0.001	0.001
NSC	3.9 d	4.6 c	5.3 a	5.2 b	0.12	0.001	0.001
NSC intake (% of DMI)	28.9 d	32.2 c	35.6 b	38.2 a	0.74	0.001	0.001
BW (kg)	384.2	382.3	382.0	383.3	2.48	ns	ns
BW change (g/d)	133.6	135.0	135.4	133.0	1.32	ns	ns

* Orthogonal polynomial contrast; L = linear, Q = quadratic,
SE = standard error of means, ns = not significant (p>0.05).

Intakes of organic matter, NDF and NSC increased linearly and quadratically (p<0.001), and CP intake increased quadratically (p<0.001) with increasing levels of CC in concentrate up to the 45 %CC in concentrate, where cows fed the 60%CC in concentrate. Total NSC intake in term of % of DMI increased linearly (p<0.001), and quadratically (p<0.001) with increasing levels of CC in concentrate (28.9, 32.2, 35.6 and 38.2% of DMI, respectively of cows fed 15, 30, 45 and 60%CC). Dietary treatment had no effect on BW change (Table 3). These data suggest that inclusion of CC up to 60% did not alter BW change in this study.

3.3 Digestibility, digestible nutrient intake

Digestibilities (%) of DM, OM, CP and NDF of cows fed different CC levels were increased quadratically (p<0.001) with increasing levels of CC in concentrate up to the 45%CC in concentrate. This reflected digestibility which was lowest at 60%CC or 38.2% NSC of DMI, and feed intake was highest in cows fed 45%CC or 35.6% NSC of DMI in concentrate.

Digestible of OM, CP and NDF intake of cows fed different levels of CC were according to nutrients intake. Therefore, digestible of CP and NDF of cows fed 30 and 45% CC were highest and significantly higher (p<0.001) than those levels of 15%CC and 60%CC, respectively (Table 4).

3.4 Urinary purine derivative excretion

The concentration of urinary purine derivatives (PD) from spot samples is shown in Table 4. Allantoin, uric acid and total PD concentrations increased quadratically (p<0.001) with increasing levels of CC in concentrate up to the 45%CC in concentrate. While dietary treatments had no effect on creatinine concentration. Similarly with allantoin/creatinine ratio increased quadratically (p<0.001) with increasing levels of CC in concentrate up to the 45%CC. Urinary PD/ creatinine ratio values used as an indicator of microbial protein synthesis, were slightly with increasing levels of CC inclusion raging from 1.1, 1.2, 1.3 and 1.0, respectively. Dietary treatments had no effect on plasma (PUN) concentration.

Table 4 Least square means for digestibility (%) of lactating dairy cows fed concentrated containing different proportions of cassava chip (CC) using urea-treated rice straw (UTRS) as roughage

	Cassava chip (CC) levels in concentrate (%)				**SE**	**Contrast***	
	15%CC	30%CC	45%CC	60%CC		L	Q
Apparent digestibility (%)							
DM	55.2 c	56.4 b	57.1 a	54.3 d	0.30	ns	0.001
OM	57.8 c	59.4 b	60.3 a	57.0 d	0.34	ns	0.001
CP	54.3 c	57.5 b	58.5 a	53.9 c	0.46	ns	0.001
NDF	52.9 c	54.8 b	55.9 a	52.1 d	0.37	ns	0.001
Digestible nutrient intake (kg/d)							
OM	6.8 d	7.6 b	8.2 a	7.2 c	0.11	0.001	0.001
CP	1.2 b	1.4 a	1.4 a	1.2 b	0.02	ns	0.001
NDF	2.8 b	3.0 a	3.0 a	2.5 c	0.05	0.001	0.001
Urinary purine derivatives (PD) and creatinine © concentration							
Allantoin (mM/l)	7.2 c	8.2 b	8.8 a	7.0 c	0.26	ns	0.001
Uric acid (mM/l)	0.70 b	0.74 ab	0.80 a	0.73 ab	0.02	ns	0.031
PD (mM/l)	7.9 c	8.9 b	9.6 a	7.8 c	0.27	ns	0.001
Creatinine (mM/l)	7.5	7.5	7.5	7.5	0.07	ns	ns
Allantoin/C ratio	1.0 c	1.1 b	1.2 a	0.9 c	0.40	ns	0.001
PD/C ratio	1.1 c	1.2 b	1.3 a	1.0 c	0.04	ns	0.001
PUN (mg%)	12.1	12.0	12.1	12.2	0.13	ns	ns

* Orthogonal polynomial contrast; L = linear, Q = quadratic, DM = dry matter, OM = organic matter, CP = crude protein, NDF = neutral detergent fiber, PUN = plasma urea nitrogen, SE = standard error of means, ns = not significant ($p>0.05$).

3.5 Milk yields and milk compositions

The influence of CC used as NSC source on lactation performance is shown in Table 5. Yields of milk (kg/d) was greatest from cows fed diets containing 45% of CC (15.81 kg), and significantly quadratically ($p<0.001$) higher than cows fed diets containing 15 and 60% CC in concentrate. In addition, milk production of 4% FCM were greatest from cows fed diets containing 30 and 45% of CC (15.45 and 16.19 kg/d), and increased linearly ($p<0.022$) and quadratically ($p<0.001$) with increasing levels of CC in concentrate up to the 45%CC in concentrate. The inclusion of CC in the diets of dairy cow fed UTRS based diets also had an effect upon milk production.

Table 5 Least square means for milk yield and milk compositions of lactating dairy cows fed concentrated containing different proportions of cassava chip (CC) using urea-treated rice straw (UTRS) as roughage

	Cassava chip (CC) levels in concentrate (%)				SE	Contrast*	
	15%CC	30%CC	45%CC	60%CC		L	Q
Milk yields							
kg/d	14.5 b	15.1 ab	15.8 a	13.8 c	0.30	ns	0.001
4 % FCM**	14.6 b	15.45 a	16.19 a	13.36 c	0.35	0.022	0.001
Fat (kg)	0.59 b	0.63 a	0.66 a	0.52 c	0.02	0.008	0.001
Protein (kg)	0.53 c	0.58 b	0.61 a	0.50 c	0.01	ns	0.001
Milk compositions (%)							
Fat	4.03 a	4.15 a	4.16 a	3.81 b	0.06	0.004	0.001
Protein	3.67 b	3.84 a	3.88 a	3.66 b	0.04	ns	0.001
Solids-not fat	9.22	9.23	9.23	9.23	0.11	ns	ns
Total solids	13.25 ab	13.37 a	13.39 a	13.04 b	0.10	ns	0.023

* Orthogonal polynomial contrast; L = linear, Q = quadratic,
** 4 % FCM = 0.4 (kg of milk) + 15 (kg of fat),
SE = standard error of means, ns = not significant (p>0.05).

Milk fat (%, kg), milk protein (%, kg/d) and total solid (TS) concentrations of cows fed different levels of CC in concentrate increased quadratically ($p<0.001$) with increasing levels of CC up to the 45 %CC in concentrate, thereafter, decreased where cows fed the 60%CC in concentrate. However, dietary treatments had no effect on solid-not fat (SNF). There was curvilinear response to the inclusion of CC in dairy cows diets, suggesting that CC inclusion improved milk yields and milk compositions up to the 45%CC in concentrate, however, increased rate of inclusion higher than 60% CC in the concentrate depressed milk yields and compositions in dairy cows fed UTRS based diets. These results suggested that the optimal level of CC in lactating dairy cow diets is between 30 to 45% in the concentrate.

4. Discussion

The NSC intake increased with increasing levels of CC in concentrate (28.9, 32.2, 35.6 and 38.2 % of DMI, respectively of cows fed 15, 30, 45 and 60%CC). Dry matter intake slightly increased with increasing levels of CC, declined thereafter where DMI for the highest level as NSC intake at 38.2% of DMI. The effect of the treatments on DMI similar to the results of [18-19]. On rice straw based diet, [18] dietary treatments containing 13.5, 27.0, 40.5 and 54.0%CC, there were curvilinear to DMI, OM and NSC intake.

Wachirapakorn et al. [19], who compared 4 levels of CC in the concentrate, the results showed that levels of CC did not have any affect on DMI, digestion coefficients of DM, OM and milk composition, however DMI in term of kg/d had linearly increased with increasing CC up to the 45%CC, thereafter, decreased where cows fed the 55%CC in concentrate.

Dry matter, OM, CP and NDF digestibility of cows fed different levels of CC in concentrate increased with increasing levels of CC up to the 45%CC, thereafter, decreased where cows fed the

60%CC in concentrate. In general, rate of digestion of carbohydrates is the major factor controlling the energy available for growth of rumen microbes [20]. Oats, cassava, wheat and barley contain high soluble fractions of starch and sugar [21]. In addition, they reported higher flows of starch to the duodenum in animals fed corn starch than when fed cassava. Total tract digestibility of cassava has been reported as ranging from 98.9 to 100 percent of intake [7, 22,-23]. In this study, DMI, digestibility and digestible nutrients intake decreased where cows fed the 60%CC in concentrate, may due to high amount of soluble carbohydrate or NSC in diets may reduce both DMI and digestibility [24-27]. Increased daily intake was associated with increased rates of substitution of cassava for oats in diets for dairy cows [28]. Cassava chips in diets has been reported to enhance net microbial protein synthesis and microbial N efficiency when compared with corn and cassava based diets was 86 and 94.1 g/d [7] and in steers fed dry rolled sorghum, dry rolled corn and dry rolled barley based diets, it was 76, 81 and 112 g/d, respectively [29]. In addition, Zinn and DePeter [7] have also reported higher N efficiency (NAN/N intake) with cassava compared to steam flaked corn diets. Therefore, a knowledge of the microbial contribution to the nutrition of host animal is paramount to developing feed supplementation strategies for improving ruminant production.

Purine derivatives (PD, including allantoin, uric acid, xanthine and, hypoxanthine) excreted in the urine of ruminants originate mainly from the microbial biomass synthesized from ruminal fermentation of ingested feed. Many studies have suggested that urinary excretion of PD by ruminants could be used as an indicator of microbial biomass and hence protein supply to the animal. This is because ruminant feeds usually contain low content of purines, most of which undergo extensive degradation in the rumen as the result of microbial fermentation [27]. Several studies have demonstrated that increased urinary PD excretion reflects changes in microbial protein flow to the small intestine [16, 29, 31-32]. It has also been suggested that purine to creatinine ratio in spot samples of urine can be used as an indicator of urinary PD excretion in intact dairy cows as a non invasive method [33-36]. Keady et al. [37] has found that concentration of PD increased with increasing starch intake.

The influence of CC on milk yields and compositions was greatest from cows fed diets containing 45% of CC in the concentrate and tended to decrease at higher level of inclusion. The inclusion of CC in the diets of dairy cow fed UTRS based diets also had an effect upon milk production. The maximum response may due to associated with the greatest intake, digestible nutrients intake, digestibility, the optimal of NSC intake and the greatest intake of both ruminal degradable starch and intestinal degradable starch [38] which would provide higher glycogenic precursors through rumen fermentation and exogenous glucose supply. In this study, similar to the results of [39], reported that the addition of cassava in the diet of dairy cows improved milk yield and milk fat. Other studies [40-42] have reported greater or similar milk production by dairy cows fed diets containing more fermentable NSC in the rumen compared with the production of cow fed ground corn plus soybean meal diets. Milk fat (yield and concentration) of cows fed 60%CC in the concentrate was decreased, similar to the results of [43] who reported that significant milk yield increases, but low milk fat yield and concentration when cows were fed diets containing high levels of starch from cereal and cassava. The influence of CC replacement on milk yields and compositions was greatest from cows fed diets containing 45% of CC as 35.6% NSC intake, and tended to decrease at higher level of inclusion (38.2%NSC intake). Similar to the results of [24, 27, 44-45] who reported that the greater milk yield and compositions when cows were fed diets containing 25-36%NSC, and low milk yield and compositions when cows were fed diets containing over 40% NSC.

5. Conclusions

Cassava chips as a source of NSC has potential to improve dairy cow performances. In this study feed intake, digestibility, nutrients intake, milk yields and milk compositions were maximal at an inclusion of 45% cassava chips (35.6% NSC intake) in the concentrate. Biologically, there was a curvilinear response to the inclusion, suggesting that the optimal level of cassava in dairy cows diets from our study was between 30 to 45% of cassava chips in the concentrate or 32.2 to 36.5% NSC intake when fed with urea-treated rice straw as fiber source.

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