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In vitro evaluation of short duration cassava varieties as livestock feed

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ABSTRACT

This study was taken up to assess the nutritional value of short duration cassava varieties, *Sree Jaya* (V_1), *Sree Vijaya* (V_2) and *Vellayani Hraswa* (V_3). The tuber, stem and leaves of above varieties were evaluated by *in vitro* gas production technique in a 3×3 factorial design. The tuber yield was the highest in V_3 variety, followed by that in V_1 and the lowest yield was observed in V_2 variety. Irrespective of cassava variety, the total ash, CP, EE and ADL content was highest in leaves. The other cell wall contents were highest in stem portion. Irrespective of the part of plant, the CP and hemicellulose contents were highest in V_3. The NDF and ADF content was highest in V_1. The protein fractionation revealed that the albumin in V_1 was higher than that in V_2 but comparable with that of V_3. The globulin in V_1 was higher than V_3. Reverse trend was observed in case of prolamins. Irrespective of cassava variety, the net gas production (NGP), NDF and true OM digestibility, ME content, methane emission, total and individual VFAs production, fermentation efficiency and efficiency of conversion of fermented hexose energy to VFA energy were highest in cassava tubers followed by stem and lowest was observed in leaves. These parameters were not affected by cassava variety, except that ME was the highest and methane emission was the lowest in V_3. It was concluded that *Vellayani Hraswa* variety and amongst different parts of cassava plant, tubers irrespective of cassava variety were observed to be highly nutritious.

Keywords: Cassava varieties, *In vitro* evaluation, Methane emission, Protein fractions

Cassava (*Manihot esculenta* Crantz) is a long duration crop that can tolerate extreme weather conditions like high temperature, heat waves and moisture stress (Nedunchezhiyan and Mohanty 2005). It is cultivated worldwide for its starchy tuberous roots, which are used as a staple food (Heuzé *et al.* 2016). For every tonne of roots that are harvested, there are an additional 600 kg of stems and leaves which also have a high potential feeding value for cattle (Ffoulkes and Preston 1978, Wanapat *et al*. 1997), and goats (Ho Quang Do *et al*. 2002). Cassava tubers are also used for ethanol production (Kuiper *et al.* 2007). Other cassava products include the finger-like leaves, which are consumed as vegetables or used as feed (Heuzé and Tran 2016). By-products from cassava processing industries like cassava flour, peels, pomace, sievate, stumps and whey are used as potential animal feeds (Boscolo *et al.* 2002, Aro *et al*. 2010).

Cassava roots for animal feeding are commonly harvested from the 9th to 12th month after cultivation (Kuiper *et al*. 2007, Gomes 1991). Suja *et al.* (2010) reported that short duration cassava (7–8 months) can be grown in rice based cropping system for crop diversification, intensification and profit maximization. However, little information is available on the cultivation of short duration cassava varieties in the Trans-Gangetic plain region of North India which experiences long cold season. Therefore, three short duration varieties like *Sree Jaya* (V_1), *Sree Vijaya* (V_2) and *Vellayani Hraswa* (V_3) were cultivated in Punjab Agricultural University. After the stipulated period, the crop was harvested and yield was recorded. But no reports are available regarding the nutritive value of different parts of short duration varieties of cassava. Therefore, leaves, stem and tubers of short duration varieties were evaluated as livestock feed by *in vitro* gas production technique.

MATERIALS AND METHODS

The short duration cassava varieties, *Sree Jaya* (V_1), *Sree Vijaya* (V_2) and *Vellayani Hraswa* (V_3) were cultivated at Punjab Agricultural University, Ludhiana with seven replicates. Setts were planted on ridges at a spacing of 75×75 cm in sandy loam soil. Fertilizers to supply N, P_2O_5 and K_2O @ 75:50:75 kg/ha were applied, half N and K_2O and full P_2O_5 was applied at the time of planting and the remaining half N and K_2O at 60 days after planting (DAP). The crop was irrigated as and when required. The crop was harvested after 8 months of cultivation. The soil was characterized by *p*H 7.4, low organic C (0.5%) and available N (216 kg/ha) and medium available P (18.3 kg/ha) and

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available K (155 kg/ha).

Chemical composition: The leaves, stem and tubers were dried in a hot air oven and ground through a 1mm sieve. The samples were analyzed for proximate principles (AOAC 2007), cellulose (Crampton and Maynard 1938) and other cell wall constituents (Van Soest *et al.* 1991). The protein in the leaves was fractionated into four protein fractions (Globulin, albumin, prolamin and glutelin) based on the solubility (Monteiro *et al.* 1982).

In vitro *studies:* The nutritional value of cassava tuber, stem and leaves were evaluated by *in vitro* gas production technique (IVGPT, Menke *et al*. 1979, Menke and Steingass 1988). Three rumen fistulated male buffalo calves used as donor for rumen contents were maintained on 2 kg conventional concentrate mixture (Maize 32, barley 20, soybean meal 15, groundnut extraction 15, rice bran 15, mineral mixture 2 and common salt 1% each), 2 kg green fodder and *ad lib.* wheat straw. About 375±5 mg finely ground cassava tuber, stem or leaves (on DM basis) was incubated with buffered rumen fluid in triplicate in a water bath at 39°C for 24 h in 100 ml calibrated glass syringes (Haberle Labortechnik, Germany). After 24 h, the volume of gas produced in each syringe was recorded and the contents of syringes were transferred to spout-less beaker, boiled with neutral detergent solution for assessing the true OM and NDF digestibility.

Estimation of volatile fatty acids: After 24 h of incubation, a 5 mL aliquot of fluid from each syringe was mixed with 1 mL of 25% meta-phosphoric acid and kept for 1h at ambient temperature (Erwin *et al.* 1961). Thereafter, it was centrifuged at 5500 rpm for 10 min and clear supernatant was collected and stored at –20°C until analyzed. The volatile fatty acids were estimated using Netchrom 9100 gas chromatograph (Cottyn and Boucque 1968).

Hydrogen balance: Hydrogen recovery, hydrogen consumed via CH_4/VFA (Demeyer 1991), VFA utilization index which represents non-glucogenic VFAs to glucogenic VFAs ratio (NGGR) and microbial biomass synthesis and methane produced during fermentation were calculated from VFA concentration (Widiawati and Thalib 2009). The energetic efficiency of rumen fermentation (E: Ørskov *et al*. 1968), efficiency of conversion of fermented hexose energy to VFA energy (E_1: Czerkawski 1986) and efficiency of conversion of fermented hexose energy to CH_4 energy (E_2: IAEA 1985) were calculated from the molar proportion of VFAs cited by Baran and •itòan (2002).

Statistical analysis: The impact of different cassava varieties and parts of plant on different parameters was analyzed by 3 × 3 factorial design (Snedecor and Cochran 1994) by using SPSS (2009) version 16.0 and the means were tested for the significant differences by using Duncan's multiple range test. The interactions were worked out between cassava varieties and parts of plant in all possible combinations (Systat 1996).

RESULTS AND DISCUSSION

The tuber yield was the highest (P<0.05) in *Vellayani Hraswa* variety (40.8 t/ha), followed by that in *Sree Jaya* (33.6 t/ha) and the lowest yield was observed in *Sree Vijaya* variety (25.2 t/ha). The yield of tubers in all the short duration varieties (Hira Singh *et al.* 2013) was much higher than the average worldwide tuber yield of 13 t/ha in 2009 (FAO 2011). Khang *et al.* (2005) have reported the fresh tuber yield of 34.5 t/ha.

Irrespective of cassava variety, the total ash, CP, EE and ADL content was highest (P<0.001) in leaves followed by stem and lowest was observed in cassava tubers, but reverse trend (P<0.001) was observed in case of OM (Table 1). The NDF, ADF, cellulose and hemicellulose content was highest (P<0.001) in stem portion followed by leaf and lowest was observed in cassava tubers, except hemicellulose which was lowest (P<0.001) in cassava leaves. The CP and EE content in leaves obtained in the present study was lower, but the cell wall constituents of leaves were much higher than those reported by Heuzé and Tran (2016), it may be due to varietal difference. Besides protein, the cassava leaves have a good amino acid profile except for methionine. They are good sources of minerals (Ca and trace elements) although P and Na contents are rather low.

Table 1. Proximate and cell wall constituents of leaf, stem and tuber of different short term varieties of cassava (% DM basis)

Parameter	Part of plant (PP)[1]			PSE	Variety (V)[2]			PSE	P value		
	Leaf	Stem	Tuber		V_1	V_2	V_3		PP	V	PP×V
Total ash	7.88^c	4.83^b	3.45^a	0.20	5.33	5.13	5.69	0.20	<0.001	0.181	0.087
OM	92.12^a	95.17^b	96.55^c	0.20	94.67	94.87	94.31	0.20	<0.001	0.181	0.087
CP	18.15^c	5.32^b	3.20^a	0.12	8.31^A	8.77^B	9.59^C	0.12	<0.001	<0.001	<0.001
EE	6.07^c	1.05^b	0.68^a	0.05	2.67	2.63	2.50	0.05	<0.001	0.075	0.188
NDF	53.03^b	64.90^c	16.60^a	0.26	47.90^C	42.70^A	43.93^B	0.26	<0.001	<0.001	<0.001
ADF	44.58^b	53.85^c	6.48^a	0.16	40.28^C	33.92^B	30.72^A	0.16	<0.001	<0.001	<0.001
Cellulose	20.73^b	35.63^c	1.33^a	0.18	19.13^B	20.33^C	18.23^A	0.18	<0.001	<0.001	<0.001
Hemicellulose	8.45^a	11.05^c	10.12^b	0.28	7.62^A	8.78^B	13.22^C	0.28	<0.001	<0.001	<0.001
ADL	19.25^c	16.82^b	6.73^a	0.20	15.05^B	14.47^B	13.28^A	0.20	<0.001	<0.001	0.001

[1]Irrespective of the cassava variety; [2]Irrespective of the part of cassava plant; V_1, Sree Jaya; V_2, Sree Vijaya; V_3,Vellayani Hraswa; Mean with superscripts^{a,b,c} for different parts of plant in a row differ significantly; Mean with superscripts^{A,B,C} for different short term cassava varieties in a row differ significantly; PSE, Pooled standard error.

Table 2. Protein fractions of leaf, stem and tuber of different short term varieties of cassava (% DM basis)

Parameter	Part of plant (PP)[1]			PSE	Variety (V)[2]			PSE	P value		
	Leaf	Stem	Tuber		V_1	V_2	V_3		PP	V	PP×V
Total proteins (TP)	20.46^b	19.54^a	23.93^c	0.170	21.31	21.19	21.44	0.170	<0.001	0.576	0.009
Albumin	1.18^c	0.40^b	0.21^a	0.020	0.65^B	0.54^A	0.60^{AB}	0.030	<0.001	0.031	0.014
Globulin	7.81^c	1.61^b	1.46^a	0.030	3.75^B	3.75^B	3.38^A	0.030	<0.001	<0.001	<0.001
Prolamins	8.28^a	16.02^b	20.68^c	0.130	14.78^A	14.89^{AB}	15.31^B	0.130	<0.001	0.047	0.194
Gluetilins	3.19^b	1.50^a	1.57^a	0.040	2.12	2.00	2.15	0.050	<0.001	0.109	0.094
Soluble proteins (SP)	8.99^c	2.02^b	1.67^a	0.040	4.41^B	4.29^B	3.98^A	0.040	<0.001	<0.001	<0.001
SP as per cent of TP	43.89^c	10.31^b	6.98^a	0.150	21.12^C	20.47^B	19.60^A	0.150	<0.001	<0.001	<0.001
Insoluble proteins (IP)	11.47^a	17.52^b	22.26^c	0.160	16.90^A	16.89^A	17.46^B	0.160	<0.001	0.044	0.385
IP as per cent of TP	56.11^a	89.69^b	93.02^c	0.140	78.88^A	79.53^B	80.40^C	0.140	<0.001	<0.001	<0.001
SP:IP	0.78^c	0.12^b	0.07^a	0.004	0.34^B	0.34^B	0.30^A	0.004	<0.001	<0.001	<0.001

[1]Irrespective of the cassava variety; [2]Irrespective of the part of cassava plant; V_1, Sree Jaya; V_2, Sree Vijaya; V_3, Vellayani Hraswa; Mean with superscripts^{a,b,c} for different parts of plant in a row differ significantly; Mean with superscripts^{A,B,C} for different short term cassava varieties in a row differ significantly; PSE, Pooled standard error.

The chemical composition of tubers was comparable to that reported earlier (Heuzé *et al*. 2016), except that the NDF content was higher in the present study. Cassava roots are considered as an excellent energy feed mainly because of high starch (70–85%) content (Ly 1998, Régnier 2011). However, crude protein content of tubers is lower than that of cereal grains. Irrespective of the part of plant, the total ash, OM and EE content were similar in all the three cassava varieties. The CP and hemicellulose contents were highest (P<0.001) in *Vellayani Hraswa* (V_3) followed by *Sree Vijaya* (V_2) and lowest was in *Sree Jaya* (V_1) variety. The NDF and ADF content was highest (P<0.001) in V_1; NDF was lowest in V_2 while ADF was lowest in V_3 cassava varieties. Cassava foliage contains 80–2000 mg hydrogen cyanide/kg DM, depending on the variety, maturity, fertilizer application and post-harvest processing (Murugesrawi *et al*. 2006). Sun-drying at 60°C (Gomez and Valdivieso 1985), wilting (Chhay Ty *et al*. 2007) and ensiling (Kavana *et al*. 2005) detoxify cassava leaves effectively.

Irrespective of cassava variety, total true protein content was the highest (P<0.001) in tubers followed by that in leaves and lowest was observed in stem (Table 2). Among the soluble proteins, albumins and globulins fractions were highest (P<0.001) in leaf followed by stem and lowest in tubers. While amongst the insoluble category, prolamins were the highest (P<0.001) in tubers followed by that in stem and lowest leaves. The gluetilins in leaves were higher (P<0.001) than that in stem and tubers, which were comparable. The soluble proteins and soluble proteins as percent of total proteins were highest (P<0.001) in leaves followed by that in stem and lowest were observed in tubers. Reverse trend (P<0.001) was observed in case of insoluble proteins and insoluble proteins as percent of total proteins. The SP to IP ratio was also highest (P<0.001) in leaves followed by stem and lowest was observed in tubers. Irrespective of the part of plant, the albumin fraction in V_1 was higher (P<0.005) than that in V_2 but comparable with that of V_3. The globulin fraction in V_1 was comparable with V_2 but higher (P<0.001) than V_3. Reverse trend (P<0.005) was observed in case of prolamins. The gluetelin content was similar in all the three varieties. The soluble protein content and SP as per cent of total proteins was highest (P<0.001) in V_1 followed by that in V_2 and the lowest was in V_3 variety. Reverse trend (P<0.005, P<0.001) was observed in insoluble protein content and IP as per cent of TP. The SP to IP ratio was similar in V_1 and V_2 varieties, but higher (P<0.001) than V_3 variety.

Irrespective of cassava variety, the NGP was highest (P<0.001) in cassava tubers followed by stem and lowest was observed in leaves (Table 3). The NDF and true OM digestibility and ME content was also highest (P<0.001) in tubers followed by leaves and lowest in stem portion. Similar trend (P<0.001) was observed in methane emission. But reverse trend (P<0.001) was observed in partitioning factor and ammonia production. Roza *et al.* (2013) revealed that cassava leaves flour (CLF) is the source of carbon frame and bypass protein increased (P<0.05) dry matter and organic matter digestibility *in vitro*. Irrespective of the part of plant, NGP, NDF and true OM digestibility; and PF were not affected by the cassava variety. The ME in V_3 was higher (P<0.001) than V_1 but comparable with V_2. The CH_4 emission from V_3 was lower (P<0.005) than V_1 and V_2, which were statistically comparable. Phanthavong *et al.* (2015) studied the effect of biochar and leaves from sweet or bitter cassava on gas and methane production in an *in vitro* rumen incubation using cassava root pulp as source of energy. The percentage of methane in the gas was lower for: (i) bitter compared with sweet cassava; (ii) fresh versus dried leaves; and (iii) from substrates with biochar than for those without biochar.

Irrespective of cassava variety, the total and individual VFAs production was the highest (P<0.001) from cassava tubers followed by that from leaves and the lowest production was observed from stem portion (Table 4). However, the valerate production was the highest (P<0.001) from the leaves followed by tubers and the lowest was observed from the stem portion. The acetate to propionate ratio was also the best (P<0.001) in tubers followed by that

Table 3. *In vitro* evaluation of leaf, stem and tuber of different short term varieties of cassava

Parameter	Part of plant (PP)[1]			PSE	Variety (V)[2]			PSE	P value		
	Leaf	Stem	Tuber		V_1	V_2	V_3		PP	V	PP×V
NGP	129.18^a	142.37^b	338.67^c	0.58	203.11	203.70	203.41	0.58	<0.001	0.762	<0.001
NDFD	26.57^b	13.03^a	59.54^c	2.48	32.71	31.26	35.16	2.48	<0.001	0.553	0.019
TOMD	59.24^b	43.15^a	93.07^c	0.66	64.23	65.17	66.07	0.66	<0.001	0.201	0.091
PF	2.79^c	2.55^b	1.10^a	0.02	2.14	2.18	2.13	0.02	<0.001	0.285	0.339
ME	7.79^b	6.20^a	11.06^c	0.01	8.42^A	8.46^{AB}	8.47^B	0.01	<0.001	<0.001	<0.001
Ammonia	0.031^c	0.018^b	0.003^a	–	0.016^A	0.016^A	0.019^B	–	<0.001	<0.001	<0.001
CH_4 (mL/100mg DM/24h)	0.74^b	0.57^a	1.30^c	0.04	0.86^B	0.85^B	0.76^A	0.05	<0.001	0.022	0.001

V_1, Sree Jaya; V_2, Sree Vijaya; V_3, Vellayani Hraswa; NGP, Net gas production (ml/24h/g DM); TOMD, True OM digestibility (%); NDFD, Neutral detergent fibre digestibility (%); PF, Partitioning factor (mg/ml); ME, Metabolizable energy (MJ/kg DM); Mean with superscripts^{a,b,c} for different parts of plant in a row differ significantly; Mean with superscripts^{A,B,C} for different short term cassava varieties in a row differ significantly; PSE, Pooled standard error.

Table 4. Total and individual volatile fatty acid production (mM/DL) from leaf, stem and tuber of different short term varieties of cassava

Parameter	Part of plant (PP)[1]			PSE	Variety (V)[2]			PSE	P value		
	Leaf	Stem	Tuber		V_1	V_2	V_3		PP	V	PP×V
TVFA	2.12^b	1.66^a	3.44^c	0.01	2.46^C	2.41^B	2.36^A	0.01	<0.001	<0.001	<0.001
Acetate (A)	1.49^b	1.13^a	2.20^c	0.004	1.63^B	1.64^B	1.55^A	0.004	<0.001	<0.001	<0.001
Propionate (P)	0.336^b	0.286^a	0.622^c	–	0.423^B	0.410^A	0.411^A	–	<0.001	<0.001	<0.001
Isobutyrate	0.024^b	0.012^a	0.039^c	0.002	0.023	0.030	0.022	0.002	<0.001	0.066	0.002
Butyrate	0.201^b	0.191^a	0.493^c	–	0.310^C	0.262^A	0.303^B	–	<0.001	<0.001	<0.001
Isovalerate	0.032^b	0.020^a	0.063^c	–	0.037^B	0.035^A	0.042^C	–	<0.001	<0.001	<0.001
Valerate	0.038^c	0.017^a	0.030^b	0.00	0.031^B	0.031^B	0.024^A	0.00	<0.001	<0.001	<0.001
A:P	4.45^c	3.97^b	3.55^a	0.01	3.93^A	4.04^C	4.01^B	0.01	<0.001	<0.001	<0.001
Relative proportion, %											
Acetate	70.18^c	68.24^b	64.05^a	0.08	67.20^B	68.52^C	66.76^A	0.08	<0.001	<0.001	<0.001
Propionate	15.77^a	17.21^b	18.04^c	0.03	17.18^C	17.01^B	16.84^A	0.03	<0.001	<0.001	<0.001
Isobutyrate	1.13^b	0.78^a	1.20^b	0.08	0.91	1.10	1.10	0.08	0.013	0.219	<0.001
Butyrate	1.14^b	0.74^a	1.10^b	0.06	0.91^A	1.10^B	1.10^B	0.08	<0.001	<0.001	<0.001
Isovalerate	1.51^b	1.22^a	1.81^c	0.02	1.46^A	1.42^A	1.64^B	0.02	<0.001	<0.001	<0.001
Valerate	1.73^c	1.06^b	0.87^a	0.01	1.30^B	1.27^B	1.09^A	0.01	<0.001	<0.001	<0.001

V_1, Sree Jaya; V_2, Sree Vijaya; V_3, Vellayani Hraswa; TVFA, Total volatile fatty acids; Figures with different superscripts^{a,b,c} in a row differ significantly; Mean with superscripts^{a,b,c} for different parts of plant in a row differ significantly; Mean with superscripts^{A,B,C} for different short term cassava varieties in a row differ significantly; PSE, Pooled standard error.

from stem and leaves. Similar trend (P<0.001) was observed in relative proportion of propionate, isobutyrate (P<0.005), butyrate and isovalerate, but reverse trend (P<0.001) was observed in relative proportion of acetate and valerate. Roza *et al.* (2013) revealed that cassava leaves flour (CLF) as the source of carbon frame and bypass protein increased (P<0.05) bacteria count and VFA production *in vitro*. Irrespective of the part of plant, the total and individual VFAs production was the highest (P<0.001) from V_1 and lowest production was observed from V_3, except that of isovalerate production where reverse trend (P<0.001) was observed. The acetate to propionate ratio was also the best (P<0.001) in V_1 followed by V_3 and lowest was in V_2 variety. The relative proportion of acetate was highest (P<0.001) in V_2 and that of propionate and valerate was observed in V_1. The relative proportion of these VFAs was lowest (P<0.001) in V_3.

Irrespective of cassava variety, the highest (P<0.001) hydrogen recovery was from tubers followed by that from stem and the lowest was observed from leaves (Table 5). Reverse trend (P<0.001) was observed in hydrogen consumption and VFA utilization index. The fermentation efficiency (E) and efficiency of conversion of fermented hexose energy to VFA energy (E_1) was highest (P<0.001) from cassava tubers followed by stem and the lowest from leaves. The microbial biomass synthesis was highest (P<0.001) in cassava tubers, while the lowest was observed in stem. Irrespective of the part of plant, the hydrogen recovery in V_3 was higher (P<0.001) than V_2 but comparable with that of V_1. Reverse trend (P<0.001) was observed in

Table 5. Hydrogen balance and efficiency of energy utilization from leaf, stem and tuber of different short term varieties of cassava (% DM basis)

Parameter	Part of plant (PP)[1]			PSE	Variety (V)[2]			PSE	P value		
	Leaf	Stem	Tuber		V_1	V_2	V_3		PP	V	PP×V
HR	29.42^a	31.94^b	34.75^c	0.05	32.33^B	31.32^A	32.46^B	0.05	<0.001	<0.001	0.112
HC	0.28^c	0.26^b	0.21^a	–	0.24^B	0.27^C	0.23^A	–	<0.001	<0.001	<0.001
VFA UI	4.66^b	4.66^b	4.38^a	0.02	4.54^A	4.51^A	4.65^B	0.02	<0.001	0.002	<0.001
E	72.14^a	73.01^b	73.92^c	0.02	73.13^B	72.82^A	73.12^B	0.02	<0.001	<0.001	0.001
E1	78.27^a	79.66^b	81.56^c	0.02	80.10^B	79.16^A	80.24^C	0.02	<0.001	<0.001	<0.001
E2	20.61^c	20.36^b	20.26^a	0.01	20.33^A	20.33^A	20.59^B	0.01	<0.001	<0.001	<0.001
MBM	53.63^b	42.82^a	89.11^c	0.11	63.26^C	61.54^B	60.74^A	0.11	<0.001	<0.001	<0.001

V_1, Sree Jaya; V_2, Sree Vijaya; V_3, Vellayani Hraswa; HR, Hydrogen recovery; HC, Hydrogen consumed via CH_4/VFA; E, Efficiency of rumen fermentation; E_1, Efficicency of fermented hexose energy to VFA energy; E_2, Efficiency of fermented hexose to methane; VFA UI, VFA utilization index; MB, Microbial biomass (g/day); Mean with superscripts^{a,b,c} for different parts of plant in a row differ significantly; Mean with superscripts^{A,B,C} for different short term cassava varieties in a row differ significantly; PSE, Pooled standard error.

case of hydrogen consumed. The fermentation efficiency (E) in V_1 and V_3 was comparable but higher (P<0.001) than V_2. But efficiency of fermented hexose energy to VFA energy (E_1) in V_3 was the highest (P<0.001), followed by V_1 and the lowest was observed in case of V_2. The microbial biomass synthesis was highest (P<0.001) in V_1 followed by V_2 and the lowest was observed in case of V_3.

It was concluded that with respect to tuber yield and nutritional worth *Vellayani Hraswa* (V_3) variety and amongst different parts of cassava plant, tubers irrespective of cassava variety were observed to be highly nutritious.

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