EFFECTS OF GRADED LEVELS OF PRO-VITAMIN A CASSAVA PEEL MEAL AND PROBIOTICS ON BLOOD PROFILE CHARACTERISTICS OF WEANER PIGS

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https://doi.org/10.35410/IJAEB.2024.5919

ABSTRACT

An eight-week study was conducted to determine the effect of graded levels of pro-vitamin A cassava peel meal (PVACPM) and probiotics (Lactic Dry) on Haematological and serum biochemical indices of weaner pigs. Forty-eight male large white weaner pigs aged eight weeks with an average weight of 9 kg were allotted to eight dietary treatments of six animals per treatment in a 4x2 factorial arrangement involving four levels (0,10,20 and 30%) of PVACPM and two probiotic levels (0 and 0.25g). Each treatment was replicated three times with two pigs per replicate, housed in pens measuring 2 m x 4 m. Feed and water were supplied daily to the pigs. At the end of the experimental period, three pigs were selected for the evaluation of heamatological and serum biochemical indices using standard procedures. Results obtained revealed that varying levels of PVACPM and probiotics significantly ($P<0.05$) impacted on heamatological and serum biochemical indices of weaner pigs. It was concluded that 30% PVACPM with or without supplemental Lactic Dry probiotic can be used in weaner pig diets for enhanced blood constituents without any adverse effect on blood profile characteristics.

Keywords: Pro-vitamin A Cassava Peels, Pigs, Probiotics, Hematological Indices, Serum Biochemical Indices.

1. INTRODUCTION

World demand for animal-derived protein will double by 2050, raising concerns for long-term sustainability and food security (Salter, 2016). The recognition of the potential of pigs as a prolific and fast-growing animal, as well as a good converter of feed to meat have made many farmers to embark on an intensive production of pigs in an effort geared towards increasing animal protein supply (FAO, 2012), The problem of high cost of feeding pigs occasioned by non-availability of feed ingredients due to competition with human has necessitated the need for the use of alternative feed ingredients like cassava peel meal. Cassava peels, the ultimate waste of cassava processing has been reported (AllAboutFeed, 2013) to serve as alternative energy source for pigs and other animals depending on the level of inclusion. Despite the consistent incorporation of cassava peels in pig nutrition, there is a dearth of information on the utilization of pro-vitamin A cassava probably due to the fact that it is a newly improved variety. Reports of Jiwuba et al. (2016) indicate high values of proximate compositions and carotenoids in pro-vitamin A cassava peels. The fibrous nature, anti-nutritional factor and imbalances in vitamins/minerals of cassava peels meal has limited its use in monogastric nutrition (Longe and Fagbenro-Byron, 1990). Supplementation with feed additives and exogenous enzymes have been reported (Torhemen et al., 2017) to enhance the utilization of cassava peels meal diets. Lactic dry probiotics is a combination of biological growth promoters and enzyme which contain useful bacterial and exogenous enzyme, it is indicated for improved fiber digestion influencing feed conversion ratio and improvement in all over gut health. The role of nutrition as a key modulator of blood profile is increasingly being recognized, a number of studies have revealed that different diets could exert diverse effects on blood profile indices of animals (Syahida et al 2012., Erukainure et al 2013; Balogun et al., 2014; Albokhadaim, 2015). Blood profile characteristics are useful in disease diagnosis and monitoring (Owoeye et al., 2011; Celik et al., 2015). According to Etim et al. (2013), the examination of blood provides the opportunity to clinically investigate the nutritional and physiological status of an individual or animal. This paper therefore seeks to evaluate the effect of varying levels of Pro-Vitamin A Cassava Peel Meal and Lactic Dry Probiotic on blood profile characteristics of weaner pigs.

2. MATERIALS AND METHODS

The study was conducted at the Pig Production Unit of SKM Livestock farm located at kilometer 5 Gboko Road Makurdi, Benue State, Nigeria. Makurdi is located on latitude $7^0$44'N and longitude $8^0$54'E. in the Southern Guinea Savannah Region of Nigeria. Pro-Vitamin A Cassava Peels were collected fresh, washed to remove silica adherents and sundried for 7days during the dry season to reduce the moisture content to about 10% or less, this was crushed using a hammer mill, sampled for analysis and stored in bags for incorporation into the diets. Lactic Dry (probiotic) was purchased from a commercial feed store in Enugu, Nigeria.

2.1 Experimental diets

Eight experimental diets T1, T2, T3, T4, T5, T6, T7, and T8 were formulated as presented in Table 1, T1 contained 0% Pro-Vitamin A Cassava Peels Meal (PVACPM) + 0g Lactic dry, T2 = 0% PVACPM + 0.25g Lactic dry, T3 = 10% PVACPM + 0g Lactic dry, T4= 10% PVACPM + 0.25g lactic dry, T5 = 20% PVACPM + 0g lactic dry, T6 = 20% PVACPM + 0.25g Lactic dry, T7 = 30% PVACPM + 0g Lactic dry and T8 = 30%PVACPM + 0.25g Lactic dry.

Table 1: Percentage composition of weaner pig diets Containing PVACPM and Lactic dry

Levels of PVACPM	0		10		20		30	
Levels of Lactic dry	0	0.25	0	0.25	0	0.25	0	0.25
Ingredients/Treatments	1	2	3	4	5	6	7	8
Maize	35.00	35.00	35.00	35.00	35.00	35.00	27.00	27.00
Full fat soya bean	20.00	20.00	22.00	22.00	23.00	23.00	24.00	24.00
PVACPM	00.0	00.0	10.00	10.00	20.00	20.00	30.00	30.00
Groundnut cake	7.00	7.00	8.00	8.00	9.00	9.00	10.00	10.00
Maize offal	20.00	20.00	16.00	16.00	5.00	5.00	3.00	3.00
Rice bran	14.90	14.90	5.90	5.90	4.90	4.90	2.90	2.90
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Common salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vit/min Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Probiotic (Lactic Dry)	-	+	-	+	-	+	-	+
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Dietary cost (₦/kg)	302	320	300	318	300	318	267	285
Calculated Nutrients								
ME (kcal/kg)	3,063.32	3,063.32	2,995.05	2,995.05	2,959.62	2,959.62	2,844.35	2,844.35
Crude protein (%)	18.04	18.04	18.14	18.14	18.13	18.13	18.26	18.26
Crude fiber (%)	6.33	6.33	5.86	5.86	5.46	5.46	5.81	5.81
Ether extract (%)	7.69	7.69	7.71	7.71	8.15	8.15	8.43	8.43
Lysine (%)	1.02	1.02	1.06	1.06	1.07	1.07	1.08	1.08
Methionine (%)	0.32	0.32	0.32	0.32	0.33	0.33	0.31	0.31
Calcium (%)	1.22	1.22	1.27	1.27	1.30	1.30	1.33	1.33
Phosphorus (%)	0.58	0.58	0.60	0.60	0.60	0.60	0.59	0.59

*Premix supplied the following per Kg of diet: Vitamin A 12000000IU, Vitamin D33000000IU, Vitamin B6 3500mg, Biotin 80mg, Antioxidant 125000mg, Cobalt 250mg, Selenium 250mg, Iron 40000mg, Manganese 70000mg, Copper 80000mg, Zinc 80000mg, Choline chloride 200000mg, Calcuim 10000mg, Vitamin B2 5000mg, Vitamin B1 2000mg, Iodine 1200mg, Niacin 40000mg, Vitamin E 30000mg, Vitamin K 32500mg, Folic Acid 1000, PVACPM= Pro-Vitamin A Cassava Peels Meal, +/-=with/without probiotics respectively, ME=Metabolizable Energy

2.2 Experimental design and management of pigs

A total of forty-eight male large white breed of weaner pigs aged eight weeks were used in a study that lasted for eight weeks. Pigs were randomly assigned to eight dietary treatments of six animals each in a factorial arrangement involving four levels (0,10,20 and 30) of PVACPM and two levels (0 and 0.25g/kg) of Lactic dry. Each treatment group was replicated three times with two pigs per replicate. Prior to the commencement of the experiment, the pigs were dewormed against endo and ecto parasites by subcutaneous injection of ivermectin using the recommended dosage. Animals were housed in pairs on concrete floored pens lined with litter material, pigs were fed weighed quantity of the experimental diets daily and drinking water was free choice through nipple drinkers.

2.3 Data collection

At the end of the experimental period, three pigs were selected for the evaluation of heamatological and serum biochemical indices. Pigs were starved of feed for 12hours after which blood collection was done in the morning before feeding. 10mls of blood was collected in serum tube through the jugular vein puncture method into two sample bottles using sterilized needle and syringe (Adesehinwa, 2007). The blood samples for serum analysis was allowed to clot before centrifuging to obtain the serum. The separated sera was decanted into bijou bottles and stored at 200℃ until analyzed. Blood parameters estimated were; Packed Cell Volume (PCV), White Blood Cell (WBC), Red Blood Cells (RBC), Hemoglobin (Hg), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC). Total Proteins (TP), Albumin, Globulin, Alanine aminotransferase (ALT), Alkaline phosphate (ALP). Aspartate aminotransferase (AST), Creatinine, Urea, Cholesterol and Glucose.

2.4 Proximate analysis

Feed samples were analyzed for their proximate components- moisture, crude fiber, crude protein, ether extract, ash and nitrogen-free extract (AOAC, 2005) and blood samples using standard methods.

2.5 Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) using the procedure of Steel and Torrie (1980) and where significant differences were observed, treatments means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

3.RESULTS AND DISCUSSION

3.1 Proximate composition of Pro-Vitamin A Cassava Peels (PVACPM)

The proximate composition of Pro-vitamin A cassava peels (PVACP) is shown in Table 2.

Table 2: Proximate composition and metabolizable energy of Pro-vitamin A cassava peels (PVACP)

Proximate components (%)						
Moisture	**Crude protein**	**Ash**	**Ether extract**	**Crude fiber**	**Nitrogen-free extract**	**Energy (KcalME/g)**
7.43	4.38	3.99	0.60	6.78	76.82	2,893.20Kcal/kg

As shown in Table 2, the Pro-Vitamin A cassava peels used in this study contained crude protein (CP) value of 4.38% which is higher than the CP values of 3.1, 2.3 and 2.1% reported by Adesehinwa et al. (2011), Otache et al. (2017) and Torhemen (2017), respectively for the white cassava cultivar. This could be due to the biofortification of the pro vitamin A cassava roots which produced the peels that were used in the present study. However, the CP value, ether extract (0.60%), ash (3.99%), moisture (7.43%) and crude fiber (6.78%) of PVACP obtained in the present study were lower than values reported by Jiwuba et al. (2021), while the nitrogen-free extract value (76.82%) and metabolizable energy value (2,893.20Kcal/kg) were higher than the values reported by the aforementioned author for PVACP. This may be attributed to the differences in the age of cassava root tubers used in the studies and the soil fertility.

3.2 Proximate composition of experimental diets

The proximate composition of experimental diets is shown in Table 3.

Table 3: Proximate composition of experimental diets

PVACPM inclusion levels (%)	0		10		20		30	
Lactic dry Inclusion levels (g)	0.00	0.25	0.00	0.25	0.00	0.25	0.00	0.25
Proximate components /Diets	1	2	3	4	5	6	7	8
Dry matter (%)	90.30	90.47	90.45	90.53	90.51	90.91	90.82	96.47
Ash (%)	8.37	9.56	10.98	10.02	10.23	15.83	27.89	13.29
Crude protein (%)	23.05	21.00	21.00	22.75	22.75	22.75	21.00	22.75
Ether extract (%)	7.38	7.08	8.28	7.47	6.44	6.00	2.72	5.37
Crude fibre (%)	7.73	8.98	7.01	6.44	6.30	4.11	7.82	6.66
Nitrogen-free extract (%)	43.77	43.85	43.18	43.85	44.79	42.22	31.31	48.40
Metabolizable energy (Kcal/kg)	2,966.05	2,871.55	2,950.10	2,660.00	2,911.33	2,783.95	2,062.05	2,946.70

ME Kcal/kg = (3.5 x protein) + (8.5 x fats) + (3.5 x nitrogen free extract) x 10

Proximate composition of experimental diets for weaner pigs presented in Table 3 revealed that diets contained adequate Dry Matter (DM), values ranged between 90.30 -90.91% and the test diets contained higher DM values than the control diet. Crude protein (CP) and metabolizable energy (ME) values were within the range recommended by (NRC, 1997) for weaner pigs, except treatment seven (7) which was slightly below recommended levels of ME. This can be attributed to the high ash content of the diet which may be probably due to processing and/or analytical error. Crude fiber (CF) in diets was lower than values reported for cassava peels meal obtained from the root of the white cassava cultivar (Torhemen et al., 2017). Results obtained on dietary composition of test diets in this present study can be attributed to the biofortification done on the cassava root tuber which may have increased the nutrient content of the test material used.

3.3 Effect of experimental diets on hematological indices of weaner pigs

The effects of varying levels of PVACPM and probiotics on hematological indices of weaner pigs is presented in Table 4 and 5

Table 4: Main Effect of PVACPM and Lactic dry on Hematological indices of Weaner Pigs

	PVACPM Inclusion Level In (%)					Lactic dry inclusion level in (g)		
Parameters	0	10	20	30	SEM	0.00	0.25	SEM
Packed Cell Volume (%)	33.67^{a}	27.17^{b}	28.67^{b}	31.33^{ab}	1.44	32.25^{a}	28.17^{b}	1.02
Red Blood Cells (10^6/µl)	5.55^{a}	4.72^{b}	4.92^{b}	4.83^{b}	0.09	5.23^{a}	4.78^{b}	0.06
White Blood Cells (10^6/µl)	7.52	7.32	7.12	7.00	0.19	7.47^{a}	7.00^{b}	0.13
Hemoglobin (g/dl)	11.25^{a}	9.00^{b}	9.49^{b}	10.42^{ab}	0.48	10.75^{a}	9.34^{b}	0.33
Mean Corpuscular Volume (fl)	58.86	56.75	57.47	56.82	0.96	60.34^{a}	54.61^{b}	0.68
Mean Corpuscular, Hemoglobin (bg)	19.64	18.97	19.16	18.94	0.33	20.12^{a}	18.23^{b}	0.23
Mean Corpuscular Hemoglobin Concentration (g/dl)	33.33^{a}	33.37^{a}	33.23^{b}	33.30^{ab}	0.03	33.26^{b}	33.36^{a}	0.02

a-b means on the same row with different superscripts are significantly (p<0.05) different, SEM =Standard Error of Mean

Table 5: Interaction Effect of PVACPM and Lactic dry on Hematological indices of Weaner Pigs

PVACPM inclusion levels (%)	0		10		20		30		
Lactic dry Inclusion levels (g)	0.00	0.25	0.00	0.25	0.00	0.25	0.00	0.25	
Parameters	1	2	3	4	5	6	7	8	SEM
Packed Cell Volume (%)	43.67^{a}	23.67^{b}	29.67^{a}	24.67^{b}	30.67^{a}	26.67^{b}	25.00^{b}	37.67^{a}	2.03
Red Blood Cells (10^6/µl)	6.10^{a}	5.00^{b}	5.30^{a}	4.13^{b}	5.13^{a}	4.70^{b}	4.40^{b}	5.27^{a}	0.13
White Blood Cells (10^6/µl)	8.13^{a}	6.90^{b}	7.70^{a}	6.93^{b}	7.93^{a}	6.30^{b}	6.10^{b}	7.90^{a}	0.27
hemoglobin (g/dl)	14.67^{a}	7.84^{b}	9.84^{a}	8.18^{b}	10.15^{a}	8.84^{b}	8.33^{b}	12.50^{a}	0.68
Mean Corpuscular Volume (fl)	70.72^{a}	47.00^{b}	55.30^{a}	58.19^{b}	58.66^{a}	56.23^{b}	56.79^{b}	56.85^{a}	1.36
Mean Corpuscular, hemoglobin (bg)	23.57^{a}	15.70^{b}	18.43^{a}	17.51^{b}	19.52^{a}	18.79^{b}	18.96^{b}	18.98^{a}	0.46
Mean Corpuscular hemoglobin Concentration (g/dl)	33.37^{a}	33.30^{b}	33.35^{a}	33.30^{b}	33.40^{a}	33.37^{b}	33.20^{b}	33.30^{a}	0.04

a-b means on the same row with different superscripts are significantly (p<0.05) different, SEM =Standard Error of Mean

It was observed that the varying levels of PVACPM had significant (P<0.05) impact on hematological parameter such as Packed Cell Volume (PCV), Red Blood Cells (RBC), Hemoglobin (HB) and Mean Corpuscular Hemoglobin Concentration (MCHC). Pigs fed diets containing 30% PVACPM had comparable PCV (31.33), HB (10.42) and MCHC (33.30) values with the control (33.67, 11.25, and 33.33) respectively. Blood is an important indication of the physiological, pathological and nutritional status of an organism, reports of Aletor, (1989) indicates that PCV and plasma protein are the most influenced variables affected by diets. The comparable PCV of weaner pigs suggest adequate absorption of nutrients, thus diets that are devoid of toxic substances which may have adverse effect on blood formation (Esonu et al., 2001). The HB values of weaner pigs indicate adequate supply of oxygen devoid of predisposition to anemia suggesting that the quality of the diets in terms of protein were not compromised and hence supported oxygen carrying capacity of blood among weaner pigs (Jiwuba et al., 2021). Result obtained can be attributed to the increased crude protein content of PVACPM as seen in proximate analysis of the test material. Similarly, hematological values of weaner pigs in this

Vol. 09, No. 04; 2024

ISSN: 2456-8643

present study were within the normal reference range for healthy weaner pigs (Oyawole et al., 2004). Results obtained agrees with reports of Oyawole et al. (2004) who reports that HB values below that which is normally seen in healthy population best characterize anemia. Red Blood Cells are responsible for the transportation of gases and nutrients, consequently decrease in RBC is an indication of poor blood cells formation by the bone marrow resulting to anemia. Jiwuba et al. (2016b) linked higher RBC concentration to better oxidation of digested feed and improved body functioning. The RBC of weaner pigs in this present study though decreasing across treatment group were within the normal reference range for healthy weaner pigs suggesting that pigs were not anemic (Oyawole et al., 2004). The comparable values of MCHC of the control group and the treatment groups were also within the normal reference range for healthy weaner pigs, suggesting no microbial infection or parasites in the blood. Result obtained implies that, including PVACPM in weaner pig diets had no negative impact on animal immunity or general health.

Result of varying levels of Lactic Dry probiotic on hematological indices of weaner pigs indicate significant ($p<0.05$) impact on all hematological parameters measured. Pigs fed diets containing no supplementation (0g) with Lactic Dry had higher values of PCV (32.25%), RBC (5.23106//ul), WBC (7.47106//ul), HB (10.75g/dl), MCV (60.34fl) and MCH (20.12bg) while MCHC (33.36g/dl) values for the weaner pigs fed 0.25g Lactic Dry were higher. Results of the present study suggest no significant improvement of hematological parameters of weaner pigs with Lactic Dry probiotic supplementation, however parameters were within the normal reference range for weaner pigs (Oyawole et al., 2004). Result of this present study confirms the report of Alkhalf et al. (2011) and Aguihe et al. (2018) who found that probiotic supplementation did not affect blood constituent's comprising PCV and HB. In contrast it disagrees with report of Centin et al. (2005) who found that probiotic supplementation caused significant increase in hematological parameters. The difference may be attributed to type and number of species of bacteria present in the probiotic used.

Result of the interaction of varying levels of PVACPM and Lactic Dry probiotic indicate significant ($p<0.05$) impact on all hematological parameters measured. Pigs fed diets containing 30% PVACPM and 0.25g Lactic Dry had similar hematological values with weaner pigs fed diets containing 0% PVACPM without Lactic Dry supplementation. This observation can be attributed to the synergy between Lactic Dry probiotic and the (30%) PVACPM level. Lactic Dry probiotic is a combination of biological growth promoters and enzymes, which might have improved the digestion of diets consequently influencing the digestion of other nutrients and thus its effect on hematological indices of weaner pigs. This observation can also be attributed to biofortification done on the cassava root tuber that produced the peels used in this present study. Result of this present study is in line with reports of Bedford and Morgan, (1996) and Chesson, (2001) who reported that dietary addition of exogenous enzyme enhances the breaking down of fiber encapsulating the more soluble constituents so that digestion can be effective. Similarly reports of Paloheimo et al., (2010) and Breanna et al. (2017) affirms that efficacy of exogenous enzyme supplementation has been reported to work in ways such as; a release of nutrients trapped within insoluble portions of diets, and the release of oligosaccharides which support beneficial microflora while suppressing pathogenic bacteria. The synergetic effect between 30% PVACPM and Lactic Dry probiotic may have influenced the improved feed utilization linked to the favorable result obtained in the diets containing 30% PVACPM and supplemental Lactic Dry.

Table 5: Main Effect of PVACPM and Lactic dry on serum biochemical indices of Weaner Pigs

	PVACPM Inclusion Level In (%)					Lactic dry inclusion level in (g)		
Parameters	**0**	**10**	**20**	**30**	**SEM**	**0.00**	**0.25**	**SEM**
Total Protein (g/dl)	5.25	5.31	5.92	5.83	4.50	5.34	5.81	3.18
Albumin (g/dl)	3.23ᵃ	2.73ᵇ	2.74ᵇ	2.55ᵇ	0.08	2.79	2.84	0.06
Globulin (g/dl)	2.02	2.58	3.18	3.28	4.42	2.55ᵇ	2.97ᵃ	3.12
Aspartate Aminotransferase (u/l)	122.77ᵃ	101.80ᵇ	81.43ᶜ	94.31ᵇ	2.66	92.48	107.67	1.88
Alamin Amino Transferase (u/l)	19.04	18.25	18.77	19.72	0.31	19.13ᵃ	18.76ᵇ	0.57
Alkaline phosphatase (u/l)	43.45	41.60	42.80	42.25	1.85	43.63	42.93	1.31
Creatine (mg/dl)	0.89ᵃ	0.75ᵇᶜ	0.80ᵇ	0.74ᶜ	0.02	0.83	0.76	0.01
Urea (mg/dl)	46.47ᵃ	39.49ᶜ	43.97ᵇ	43.29ᵇ	0.61	43.43ᵃ	43.18ᵇ	0.43
Cholesterol (mg/dl)	94.13	99.43	88.68	85.46	4.29	95.08	88.77	3.03
Glucose (mg/dl)	57.02ᵇ	67.97ᵇ	89.20ᵃ	73.38ᵃ	5.25	68.69	75.09	3.71

a-b means on the same row with different superscripts are significantly ($p<0.05$) different, SEM =Standard Error of Mean

Table 6: Interaction Effect of PVACPM and Lactic dry on serum biochemical indices of Weaner Pigs

PVACPM inclusion levels (%)	**0**		**10**		**20**		**30**		
Lactic dry Inclusion levels (g)	**0.00**	**0.25**	**0.00**	**0.25**	**0.00**	**0.25**	**0.00**	**0.25**	
Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**SEM**
Total Protein (g/dl)	6.06	6.44	5.48	5.12	6.00	5.83	5.83	5.82	6.37
Albumin (g/dl)	3.22	3.24	2.72	2.74	2.69	2.78	2.52	2.58	0.12
Globulin (g/dl)	2.84	3.20	2.76	2.38	3.34	3.05	3.31	3.24	6.25
Aspartate Aminotransferase (u/l)	119.69	125.85	91.23	112.38	75.47	87.39	83.54	105.08	3.75
Alamin Amino Transferase (u/l)	20.88	17.20	18.25	18.25	18.07	19.47	19.30	20.13	1.15
Alkaline phosphatase (u/l)	47.70	39.20	41.60	41.60	41.20	44.40	44.00	46.50	2.62
Creatine (mg/dl)	0.79ᵃ	0.70ᵇ	0.80ᵃ	0.70ᵇ	0.93ᵃ	0.68ᵇ	0.72ᵇ	0.76ᵃ	0.03
Urea (mg/dl)	47.65ᵃ	46.89ᵇ	40.74ᵃ	38.24ᵇ	44.60ᵃ	43.35ᵇ	43.30ᵇ	47.34ᵃ	0.87
Cholesterol (mg/dl)	93.17ᵃ	91.10ᵇ	114.50ᵃ	84.37ᵇ	90.30ᵃ	87.05ᵇ	83.37ᵇ	97.55ᵃ	6.07
Glucose (mg/dl)	66.48ᵃ	46.55ᵇ	98.93ᵃ	47.84ᵇ	56.09ᵇ	58.30ᵃ	62.30ᵇ	63.67ᵃ	7.43

a-b means on the same row with different superscripts are significantly ($p<0.05$) different, SEM =Standard Error of Mean

ISSN: 2456-8643

It was observed that the varying levels of PVACPM had significant (P<0.05) impact on serum biochemical parameters such as Albumin, Aspartate Aminotransferase (AST), Creatine, Urea and Glucose. Parameters decreased with increasing levels of PVACPM with exception of glucose which increased in the test diets and was highest in the diets containing 20% PVACPM. Serum albumin is a strong predictor of health, and a low albumin concentration is a sign of poor health (Oyawole et al., 2004). Result of this present study indicate TP values suggesting that protein levels in the weaner pig diets were able to support the normal protein reserve in the pigs in all groups. Moreso that the average serum globulin content of the diets across the groups were unaffected and albumin values were within the normal reference range for healthy weaner pigs (Oyawole et al., 2004). The AST value obtained in this present study for the control (122.77u/l) was higher than weaner pigs fed diets containing varying levels of PVACPM, these ranges were within values of AST for healthy weaner pigs (Oyawole et al., 2004). This is an indication that PVACPM diets were of good quality that support weaner pig growth (Jiwuba et al., *2021*). Blood Creatine which was significantly (p<0.05) affected indicate that the control group had the highest values (0.89mg/dl) while pigs fed 10% (0.75) PVACPM had comparable creatine values with the 20% (0.80mg/dl) and 30% (0.74mg/dl) PVACPM fed group of pigs. Blood creatine is an indicator of kidney damage resulting from excess breakdown of blood protein catabolism, high blood creatine would indicate muscle wastage and implies that the animal is surviving at the expense of body reserves which also results in weight loss (Jiwuba et al.,2021). Blood creatine values in this present study suggest that weaner pigs were not surviving at the cost of their body reserves as evident by the fact that they did not lose weight during the experiment. Blood Urea was also significantly (p<0.05) affected. Ammonia is produced by the body after eating protein and the liver produces urea as a waste product of protein digestion therefore blood urea is an index for evaluating protein quality or excessive protein intake (Coma, 1996). Decreasing values of urea in weaner pig diets across treatment groups suggest a decreasing protein quality as levels of PVACPM increase in weaner pig diets. However, values obtained were within the normal reference range for healthy weaner pigs (Oyawole et al., 2004). Blood glucose was significantly (p<0.05) affected, the highest value (89.20mg/dl) was recorded in pigs fed 20% PVACPM while the control (57.02mg/dl) had the least value. This observation suggest that weaner pigs probably were able to fully digest and absorb dietary nutrients which supported muscle development and deposition. Result of this present study confirms the report of Ogunbode et al. (2016) who found that nutrition and diet content affects' the blood values of animals.

Result of varying levels of Lactic Dry probiotic on serum biochemical indices of weaner pigs indicate significant (p<0.05) impact on parameters such as Globulin, ALP and blood urea. Pigs fed diets containing 0.25g Lactic Dry had higher values of globulin (2.97g/dl) as against the non-supplemented group which had globulin value of (2.55g/dl), The ALP (19.13u/l) and urea (43.43mg/dl) values were higher for weaner pigs that received no supplementation. The supplemented and non-supplemented diets though statistically different, values of globulin, ALP and urea obtained from feeding these diets were within the normal reference range for healthy weaner pigs (Oyawole et al., 2004).

The interaction of varying levels of PVACPM and Lactic Dry probiotic on serum biochemical indices of weaner pigs indicate significant (p<0.05) impact on parameters such as creatine, urea, cholesterol and glucose. Result obtained revealed that weaner pigs fed diets containing no supplemental Lactic Dry (0g) recorded higher values of serum parameters. However, the trend changed at 30% PVACPM and 0.25g supplemental Lactic Dry, serum metabolites values obtained (0.79, 47.65, 93.17 and 66.48mg/dl) for creatine, urea, cholesterol and glucose respectively were similar with the values (0.76, 47.34, 97. 55, and 63.67mg/dl) obtained for pigs fed 0% PVACPM and 0g Lactic Dry supplementation. This indicates that aforementioned dietary treatment compared favorably with the basal control diet as evident in the serum metabolites obtained. This observation can be attributed to the synergetic effect between 30% PVACPM and Lactic Dry probiotic which probably may be due to biofortification done on the cassava root tuber that produced the peels used in this study and the probiotic effect. Result obtained were within the normal reference range for seemingly healthy weaner pigs (Oyawole et al., 2004).

4. CONCLUSION

The study revealed that PVACPM can be used in weaner pig diets to sustain normal blood profile characteristics without any adverse effect on the health status of animals; 30% PVACPM with or without supplemental probiotic is recommended.

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