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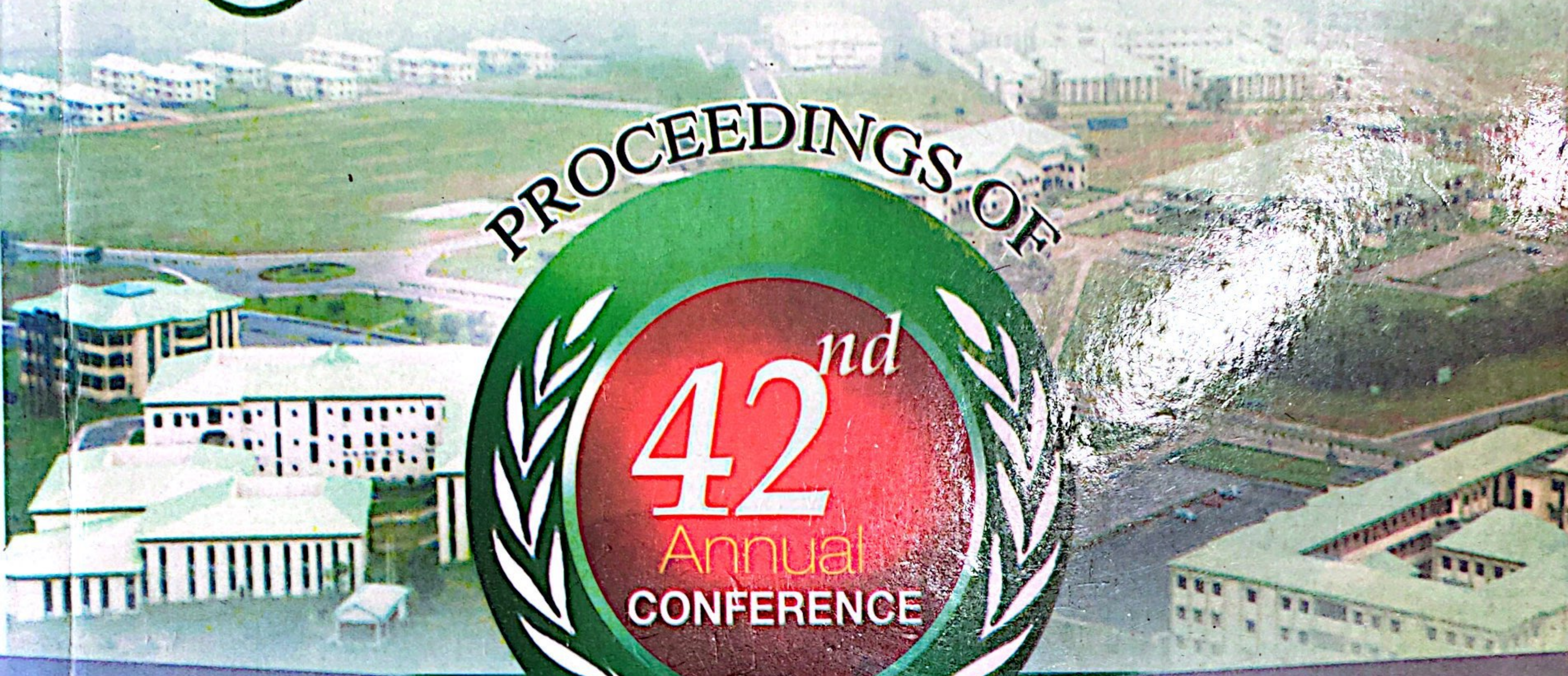

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GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND GUT MORPHOLOGY OF COCKERELS FED DIETS CONTAINING VARYING LEVELS OF COWPEA (*Vigna Unguiculata*) MILLING WASTE MEAL

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ABSTRACT
Three hundred (300) one-week old Bovan Nera cockerel chicks were used to investigate the effect of feeding diets containing varying levels of cowpea milling waste meal (CMWM) on growth performance, nutrient digestibility and gut morphology of cockerels. The birds were randomly allocated to five dietary treatments, with three replicates per treatment made up of twenty birds per replicate, in a completely randomized design experiment. The treatments were 0, 10, 20, 30 and 40 % dietary inclusion levels of CMWM and were tagged $CMWM_0$, $CMWM_{10}$, $CMWM_{20}$, $CMWM_{30}$ and $CMWM_{40}$ respectively. The experiment lasted for eight weeks and data on growth performance were taken. At the end of the 7th week of the experiment, a nutrient digestibility trial was carried out. Two birds per replicate were selected and placed in specially constructed metabolism cages for seven days; three days to acclimatize them and four days for faecal collection. Gut morphology data were taken at the termination of the feeding trial at the 8th week of the experiment. One bird was selected per replicate and slaughtered by cervical dislocation and the internal organs weighed. Results show that birds on $CMWM_{30}$ had the highest feed intake (1531.67) and the ones on $CMWM_0$ had the lowest (1120.46); birds on $CMWM_{30}$ had the highest final bodyweight (428.47) and the ones on $CMWM_0$ had the lowest (354.57). FCR results indicated that birds on $CMWM_{10}$ (3.28) and $CMWM_0$ (3.55) were better than those on $CMWM_{30}$ (4.07). The dietary treatments had effect ($P<0.05$) on dressing % and weight of GIT, small intestine, large intestine and lungs. Result of digestibility trial show that dietary treatments had no effect on the digestibility of the nutrients by the birds. Therefore, it is recommended that up to 40 % of CMWM can be included in the diets of cockerels with no detrimental effects on their growth performance and nutrient digestibility but better gut morphology was obtained with $CMWM_{20}$.

Keywords: Growth performance, nutrient digestibility, gut morphology, cockerels.

INTRODUCTION
Feeding has an important role to play in poultry production when higher quality product and fast growth rate are desired. The feeding of poultry birds attracts between 70 and 75 % of the total cost of production because of the high cost of conventional feed ingredients (Afolayan, 2008). The major problem associated with the use of conventional plant protein seeds in compounding livestock rations is the competition between man and livestock for these vital protein sources. However, the industrial processing of protein grain by-products which are regarded as wastes for man but can serve as feed for livestock can help to considerably reduce the cost of feeding of poultry. One of these grain milling by-products is the cowpea milling waste meal obtained from the industrial processing of cowpea seed into beans flour which has potential as a valuable feed resource for feeding of cockerels. Various studies have shown that cowpea is a good source of protein to man and animals; its milling waste contains up to 24 % crude protein and the nutrient can easily be utilized by livestock (Davis *et al.*, 1991).Therefore, the objective of this research study is to determine the growth

performance, nutrient digestibility and gut morphology of cockerels fed diets containing varying levels of cowpea (*Vigna unguiculata*) milling waste meal.

MATERIALS AND METHODS

Experimental Diets

Cowpea milling waste meal (CMWM) was purchased at the Kitchen Friendly Limited, an agro-processing company located at Nyikangbe, Off Bida Road, Minna, Niger State. The waste was acquired as a by-product from the industrial processing of cowpea grains. The meal was used to compound cockerel diets at inclusion levels of 0, 10, 20, 30 and 40 % to form diets 1, 2, 3, 4 and 5 respectively (Table 1).

Experimental Birds and their Management

Three hundred (300) Bovan Nera cockerel chicks purchased from Dayntee Farm in Ajashe-Ipo, Kwara State Nigeria, were used for the study. The experiment was carried out under intensive system of management with feed and water supplied *ad-libitum*. Poultry pens used for the study were cleaned and disinfected with germicide (IZAL) prior to the stocking of the birds. Litter materials used was wood shavings. The floor spaces were covered with wood shavings and the wall covered with polythene sheets to keep the pens warm, particularly during brooding period. Electric bulbs and rechargeable lamps were used as sources of illumination while coal pots served as sources of heat for the birds. On arrival, the birds were de-boxed, counted and made comfortable in their pens. They were then served medicated water containing glucose, antibiotics and antistress. Thereafter, they were adjusted in the cases for one week during which period they were fed the Control Diet At the end of adjustment period, the birds were weighed and randomly allocated to the five dietary treatments made up of three replicates per treatment and 20 birds per replicate. The experiment lasted for eight weeks. A standard vaccination schedule as recommended by the Nigerian Veterinary Medical Association for the region was followed strictly.

Parameters Determined

Using standard procedures as described by Adesida *et al.* (2010) ,
growth performance parameters such as feed intake, body weight gain and feed conversion ratio were determined.

At the end of the 7th week of the experiment, a nutrient digestibility trial was carried out using the total collection method. This involved the selection of two birds from each replicate and putting them in specially constructed metabolism cages for seven days. In the first three days, the birds were allowed to acclimatize to the environment in the cages, followed by four days' collection of faecal samples from each replicate. The collected faeces were weighed and dried in an oven at 85°C till a constant weight was attained; and the samples for each replicate bulked together and weighed. Representative samples were then taken for proximate analysis. Difference between the nutrients consumed and nutrients voided in the faeces multiplied by 100 gives the apparent nutrient digestibility coefficient of the feed according to the method described by Isikwenu *et al.* (2010).

Gut morphology was determined at the end of the 8th week of the experiment (when the birds were nine weeks old). Two cockerels per replicate were selected at random and kept off feed for eight hours; but provided with water. Each of the birds was weighed and killed by cervical dislocation, scalded in hot water, eviscerated and the different internal organs weighed.

Chemical Analysis

The proximate composition of CMWM, the experimental diets and the collected faecal samples were determined using the procedures of AOAC (1990).

Statistical Analysis

All data were subjected to one way analysis of variance (ANOVA) based on the Completely Randomized Design model, using Statistical Analysis System (SAS, 2012). Where differences existed at 5 % ∝-level, they were separated using Duncan's Multiple Range Test (SAS, 2012).

RESULTS AND DISCUSSION

The CP content of CMWM is 24.85 % (Table 2); this is close to the value of 20.30 % obtained by Malik *et al.* (2015) showing that CMWM is good source of protein for poultry. The CP content of the experimental diets ranged from 20.41 to 22.11 %; this meets the dietary CP requirement of cockerels as recommended by Aduku (1993) and Olomu (2011) for the tropics. Feed intake and hence final body weight were significantly ($p<0.05$) higher for the CMWM-based diets than for the Control diet, although body weight gain were not significantly ($p>0.05$) different among the treatment groups (Table 3). Also, there were no significant ($p>0.05$) differences in the digestibility of nutrients among the treatment groups (Table 4). This result is similar to the report of Apata and Ologhobo (1994) and Ani and Omeje (2007), who observed that feed intake in the diet containing cowpea testa and raw bambara nut waste correspondingly increased with increasing levels of their inclusion in the diet. Average body weight gain is similar to those of Akanji *et al.* (2015) who reported that cowpea based diets showed no significance difference in weight gain between the test diets and the control diet. For gut morphology (Table 5), The GIT and small intestine weight was significantly ($p<0.05$) higher for the CMWM diets than for the Control diet while $CMWM_{20}$ had significantly ($p<0.05$) higher live weight, dressing %, large intestine % and lungs % than the other treatments. This is similar to what was obtained by Ngiki *et al.* (2014) that the dressed weight of broiler chicks increased as the level of cassava meal increased in the diets up to a point, indicating the maximal utilization of the test ingredient.

CONCLUSION

It can be concluded that for optimum growth performance and nutrient digestibility, CMWM can be included up to 40 % in the diet of cockerels; however, 20 % inclusion level gave better results for optimum gut morphology.

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Table 1 Composition of the experimental diets fed to cockerels

	Level of cowpea milling waste meal (%)				
Ingredients	$CMWM_0$	$CMWM_{10}$	$CMWM_{20}$	$CMWM_{30}$	$CMWM_{40}$
Maize	48.50	41.50	35.00	28.40	21.30
Maize offal	14.90	14.50	14.40	14.00	14.40
Ground nut cake	31.00	28.40	25.00	22.00	18.50
CMWM	0.00	10.00	20.00	30.00	40.00
Bone meal	3.55	3.55	3.55	3.55	3.55
Lysine	0.50	0.50	0.50	0.50	0.50
Methionine	0.50	0.50	0.50	0.50	0.50
Salt	0.30	0.30	0.30	0.30	0.30
*Premix	0.25	0.25	0.25	0.25	0.25
Lime stone	0.50	0.50	0.50	0.50	0.50
TOTAL	100	100	100	100	100
Calculated Analysis					
Crude protein	20.04	20.23	20.14	20.19	20.07
ME(Kcal/kg)	2728	2732	2738	2746	2746
Crude fibre	4.01	4.06	4.13	3.42	3.57
Lysine	1.20	1.27	1.37	1.47	1.07
Available phosphorus	0.90	0.85	0.87	0.89	0.91
Calcium	1.60	1.56	1.57	0.73	0.80
Methionine	0.74	0.76	0.77	0.73	0.80
Ether extract	5.03	5.42	5.76	6.14	6.46

*0.25kg of Premix contained vitamin A=1,000,000 IU, vitamin D_3=2,000 IU, ,vitamin E=2,300 IU ,vitamin K_3= 200mg ,vitamin B_1=180mg, vitamin B_2=550mg, niacin =2750 mg, pantothenic acid =750 mg, vitamin B_6=300 mg, vitamin B_{12}=15mg, folic acid=75mg, biotin = 6mg, choline chloride = 30000 mg, cobalt = 20 mg, copper = 300 mg,, iodine = 100mg, iron = 2000 mg, manganese = 4000 mg, selenium =20 mg, zinc = 3000 mg, antioxidant = 125 mg.
CMWM = Cowpea milling waste meal   ME = Metabolizable energy

Table 2 Proximate composition of cowpea milling waste meal and the experimental diets

Parameters (%)	Control	$CMWM_{10}$	$CMWM_{20}$	$CMWM_{30}$	$CMWM_{40}$	CMWM
Dry matter	91.30	95.00	90.20	90.32	86.50	97.00
Crude protein	21.04	21.63	22.11	20.41	20.98	24.85
Crude fibre	2.50	2.50	3.00	3.00	3.00	14.00
Ether extract	10.50	7.50	11.00	9.50	8.50	5.00
Ash	9.50	9.50	6.50	10.00	9.50	9.00
NFE	47.76	53.87	47.59	47.49	44.52	44.15

CMWM = Cowpea milling waste meal
Control = 0 % inclusion level
$CMWM_{10}$ = 10 % inclusion level
NFE = Nitrogen free extracts
$CMWM_{20}$ = 20 % inclusion level
$CMWM_{30}$ = 30 % inclusion level
$CMWM_{40}$ = 40 % inclusion level

Table 3 Growth performance of cockerel chicks fed diets containing varying levels of cowpea milling waste meal for the period of fifty six days

Parameters	$CMWM_0$	$CMWM_{10}$	$CMWM_{20}$	$CMWM_{30}$	$CMWM_{40}$	SEM	LOS
Feed intake (g)	1120.46^{d}	1183.06^{cd}	1307.50^{bc}	1531.67^{a}	1453.59^{ab}	46.35	*
Initial body weight(g)	48.61	48.64	50.36	52.08	46.92	0.86	NS
Final body weight(g)	364.57^{b}	409.72^{ab}	406.25^{ab}	428.47^{a}	422.92^{ab}	9.14	*
Body weight gain(g)	315.96	361.08	355.89	376.39	376.00	9.12	NS
Feed conversion ratio	3.55^{ab}	3.28^{a}	3.69^{abc}	4.07^{c}	3.89^{bc}	0.09	*

^{ab} Means in the same row with different superscripts were significantly different ($P<0.05$)

SEM = Standard Error of Mean LOS = Level of significance CMWM = Cowpea milling waste meal
$CMWM_0$ = 0 % inclusion level $CMWM_{10}$ = 10 % inclusion level $CMWM_{20}$ = 20 % inclusion level
$CMWM_{30}$ = 30 % inclusion level $CMWM_{40}$ = 40 % inclusion level

Table 4 Nutrient digestibility of cockerels fed diets containing varying levels of cowpea milling waste meal

Parameters	Control	$CMWM_{10}$	$CMWM_{20}$	$CMWM_{30}$	$CMWM_{40}$	SEM	LOS
Dry matter	82.54	79.85	84.16	79.86	75.26	2.05	NS
Crude protein	66.65	59.73	63.85	58.37	48.82	3.15	NS
Crude fibre	10.33	65.02	10.77	27.80	29.43	1.02	NS
Ether extract	76.35	52.68	71.78	72.51	72.34	4.60	NS
Ash	65.54	46.24	44.39	54.37	47.68	4.29	NS
NFE	84.43	87.10	85.65	81.44	75.24	1.75	NS
TDN	71.54	67.72	72.15	67.38	58.86	1.98	NS

SEM = Standard Error of Mean LOS = Level of significance NFE = Nitrogen free extract
TDN = Total digestible nutrient CMWM = Cowpea milling waste meal Control = 0 % inclusion level
$CMWM_{10}$ = 10 % inclusion level $CMWM_{20}$ = 20 % inclusion level $CMWM_{30}$ = 30 % inclusion level
$CMWM_{40}$ = 40 % inclusion level NS = Not significant

Table 5 Effect of feeding diets containing varying levels of cowpea milling waste on relative gut morphology of cockerel chicks

Parameters	Control	$CMWM_{10}$	$CMWM_{20}$	$CMWM_{30}$	$CMWM_{40}$	SEM	LOS
Live weight (g)	555.00^{ab}	493.66^{b}	660.00^{a}	492.33^{b}	485.66^{b}	7.26	*
Dressing %	61.92^{ab}	61.02^{b}	64.09^{a}	60.63^{b}	60.34^{b}	0.47	*
GIT %	14.15^{b}	16.24^{ab}	14.66^{ab}	16.42^{a}	16.17^{ab}	0.35	*
Crop %	0.79	1.08	0.74	0.69	0.70	0.06	NS
Proventriculus %	0.53	0.54	0.56	0.56	0.60	0.01	NS
Gizzard %	4.35	5.11	4.87	5.18	4.95	0.16	NS
Small intestine %	2.86^{b}	3.04^{ab}	3.55^{a}	3.49^{a}	3.48^{a}	0.98	*
Large intestine %	0.72^{ab}	0.29^{b}	1.04^{a}	0.42^{b}	0.38^{b}	0.09	*
Heart %	0.62	0.55	0.57	0.60	0.56	0.20	NS
Liver %	1.778	1.98	1.95	1.88	2.22	0.06	NS
Kidney %	1.00	1.00	0.70	0.85	0.77	0.07	NS
Lungs %	0.56^{ab}	0.51^{b}	0.80^{a}	0.64^{ab}	0.75^{ab}	0.04	*
Spleen %	0.13	0.11	0.11	0.09	0.11	0.01	NS

^{ab} Means in the same row with different superscripts were significantly different ($P<0.05$)

SEM = Standard Error Of Mean LOS= Level of Significance CMWM: Cowpea Milling Waste Meal
GIT = Gastro-Intestinal Tract Control = 0 % inclusion level $CMWM_{10}$ = 10 % inclusion level
$CMWM_{20}$ = 20 % inclusion level $CMWM_{30}$ =30 % inclusion level $CMWM_{40}$ = 40% inclusion level.