Improving silage quality, Performance and behavior of Mulard ducklings fed complete silage ration supplemented with organic acids.

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Abstract

The goal of our study was to evaluate the effects of different levels of organic acids (OAs) on silage quality and growth performance, digestibility, carcass traits and behavior of Mulard duckling fed anaerobically fermented feed. Mulard duckling (n=200) was divided randomly into four groups of five replicate each. Four diets were formulated as follows: control silage diet without additives (S1) and 0.5,1 and 2% of organic acids blend were used for 2nd (S2), 3th (S3) and 4th (S4) treatments during starter and finisher period. The results revealed that, addition of OAs to silage decreased nutrient loss during fermentation process. The results related to growth performance revealed that the highest body weight and body weight gain were observed in the group supplemented by 2% organic acids. Moreover, the improved feed conversion ratio and protein efficiency ratio were recorded in groups fed on complete ration silage supplement with 1 and 2%. OAs followed by groups supplemented with 0.5% OAs when compared with the control group. Also, nutrient digestibility of ducks was improved with increasing level of OAs supplementation for silage. Addition of OAs blend to silage has a positive significant effect on carcass weight and breast and thigh yield. The crude protein content was increased in breast and thigh, also the amount of fat was decreased in breast meat while it was not affected in thigh meat by addition of OAs. Concerning the eating and drinking frequencies were the highest in control silage group and group supplemented with 0.5% OAs when compared with silage supplemented groups with 1 and 2% OAs. Ducks reared on silage with 2% OAs diet were more active, as expressed by greater walking, wing shaking, leg stretch, preening and flying. Briefly, our results suggested that addition of OAs to silage improved its quality and greatly affects duckling's performance.

Keywords: Organic acids, Silage quality, Duck, Performance

1. Introduction:

Traditional Duck feed still depend on moistening dry feed and wet feed can be produced directly by water addition and anaerobic fermentation (**Adil et al. 2010**).The feed ingredients with high moisture content is more suitable for fermented preservation. On other hand, increasing moisture content during feed processing, making it difficult for the storage and direct utilization. Thus, anaerobic fermentation could increase the stability of post-harvest feed stuff and has other benefits for animal health (**Akinola et al., 2015**). Fermentation technology is a method of preserving a feed through maintaining its quality and to some extent improving its quality. Also, ensiling is used for preservation of moist by-products for later feeding. However, ensiling of by-products alone makes the adequate fermentation process to be difficult to attain due to high-moisture contents and deficiency of sugar substrates. On other hand, addition of other feed additives as acidifiers during fermentation process for highly moisture feed content during ensiling could enhance the preservation process and protecting feed from microbial and fungal destruction (**Christian, 2015**). In addition, acidifiers could be used as performance promoters and powerful tool in maintaining the health of gastrointestinal tract of poultry, by suppressing the growth of acid intolerance bacteria such as E-coli, salmonella spp., and Clostridium perfringens (**Naseri et al., 2012**). Moreover, it can enhance the bird's immunity (**Grashorn, 2010**) and the solubility of minerals (**Swiatkiewicz et al., 2010**).For example, propionic acid, used effectively for high moisture grain preservation (**Filya et al., 2004; Samli et al., 2008**) also, has possible role in depressing microbial activity. Formic acid, as silage additive, has anti-bacterial effect, limit the process of fermentation and reduce silage content from organic acids (**Filya et al., 2004**). Moreover, the role of organic acids in feed can reduce gastric pH which enhances pepsin activity, thereby facilitating the absorption rate of proteins, amino acids, and minerals (**Park et al., 2009**). Among other gut acidifiers are salts, of potassium di-formate, has effective role against pathogenic bacteria in gastrointestinal tract (**Huyghebaert et al., 2011**). Anaerobically fermented feed given to broiler chickens has been reported to sustain gut condition and improve performance (**Merryana, 2007**) without affecting the morphology of intestinal villi (**Milbradt et al., 2014**). Male ducks fed anaerobically fermented wet feed with a water content of 50% (which can support ensilage process) lead to best quality feed based on feed conversion ratios (**Allaily et al., 2011**) and local ducks in Vietnam showed improved feed intake, growth rates and feed conversion (**Tien et al., 2014**).As organic acid could have a prominent role on silage fermentation and its quality and as feed additives for duck's production. The purpose of this study was to investigate the effect of addition of organic acids mixtures on silage quality and growth performance of young ducks.

2. Material and Method:

The research protocol was reviewed and approved by the Animal Care and Welfare Committee of the Faculty of Veterinary Medicine, Zagazig University.

2.1. Ducks and housing:

Two- hundred one-day-old Mulard ducklings were obtained from a commercial duck hatchery. On arrival, the ducks were weighed and distributed into four experimental groups; each group contained 50 ducklings that were equally subdivided into five replicates and raised for 42 days in floor pens on deep litter. The temperature was kept at 33°C up to 3 days of age, and then it was reduced gradually to room temperature.

Table1 composition of experimental diets

Ingredient (%)	Starting diet (0-21)	Growing-overfeeding diet (22-42)
Corn	44	57
Soy bean meal (44%)	36.6	22.3
Wheat bran	6	6.8
Barely	7.5	7.6
Soybean oil	2.5	2.6
Di-calcium phosphate	1.5	1.5
Ca carbonate	0.8	0.9
Na chloride	0.3	0.3
Premix[1]	0.5	0.5
Methionine	0.1	0.1
Lysine	0.2	0.4
Calculated nutrient content		
Crude protein (%)	21.55	16.54
Ether extract (%)	2.50	2.86
Crude fiber (%)	3.47	3.33
Metabolizable energy (kcal/kg)	2900	3003
Lysine (%)	1.45	1.27
Methionine (%)	0.43	0.36

Muvco premix 1: Each 2.5kg contain vit. A (10, 000000 IU), vit. D3 (2, 000000 IU), vit. E (10 g), vit.k3 (1000 mg), vit. B1 (1000 mg), vit. B2(5 g) ,vit.B6 (1.5 g) , pantothenic acid (10 g) ,vit. B12 (10 mg), niacin(30 g) , folic acid (1000 mg), biotin(50 mg) , Fe (30 g), Mn (60 g),Cu (4 g), I (300 mg), Co(100 mg) , Se (100 mg) and Zn(50 g)
ME (metabolic energy), **CF** (crude fibre) and **Ca** (calcium).

2.2. Diets and experimental design:

The following feed stuff were used for making silage in this study: Yellow corn, soybean meal, wheat bran, barely (S1) were mixed to match the requirements of Mulard ducks (**NRC 1994**) and inoculum of 0.5,1 and 2% of acidifier blend were used for 2nd (S2), 3th (S3) and 4th (S4) treatments. The commercial acidifier mixture (OAM) contained formic acid (150 g/kg), propionic acid and calcium propionate (30 g/kg) (AcidbacTM, Dexib'erica, Vila-Seca and Tarragona, Spain). Ducklings feeding program consisted of starter diet (up to 21 days) and grower diet (22-42 days).

2.3. Anaerobic fermentation for silage:

All dietary ingredients were mixed according to the formulas in Table 1, with a water content of 45% for control group, in the S2, S3 and S4 treatments, silage was firstly made by adding 0.5, 1 and 2% acidifier blend in distilled water and then mixed with the feed with water content of (45%). Approximately 50 kg of mixed ration was then compacted in a plastic bag. The air tight plastic container was sealed and stored to obtain good anaerobic fermentation conditions for 4 weeks.

2.4. Chemical composition and pH of silage:

Dry matter (DM) and Crude protein (CP), ether extract (EE) and crude fiber (CF) in silage were determined following the procedure of Association of Official Analytical Chemists (**AOAC, 2002**).

To determine the pH values of silage 15g of each sample was transferred to a 250 mL beaker and 200 mL of distilled water were added. Then pH values were measured by digital pH meter (Hanna HI-2211).

2.5. Growth performance:

At the end of each experiment performance parameters were recorded: body weight (BW), body weight gain (BWG) = final live weight – initial live (g) according to (**Wagner et al 1983**), Feed intake (FI), feed conversion ratio (FCR) = Amount of feed consumed (g)/ Body weight gain (g). Protein efficiency ratio (PER) = Live weight gain (g) / Protein intake (g) was determined according to (**McDonald 2002**).

2.6. Apparent nutrient digestibility:

At 42 day of the experiment 2 birds/ replicate were retained for measuring apparent digestibility using the same grower diet with adding 0.5% titanium oxide as an indigestible marker for 10 days. The bird's excreta were collected without feather or feed residues twice daily for the last 5 days. The titanium oxide concentration in the excreta was measured according to (**Short et al. 1999**). The uric acid content of the excreta was measured according to (**Marquardt 1983**). The apparent digestibility of dry matter, crude protein and crude fiber was calculated by equation of (**McDonald 2002**)

2.7. Slaughter traits:

On day 42, three ducks from each group were randomly selected, fasted overnight, weighed and scarified to obtain weight of dressed carcass, breast, and thigh. The weight of small intestine, proventiculus, gizzard, and liver were recorded. The length of duodenum, jejunum, ileum, cecum, rectum small intestine was also detected.

A sample from breast and thigh meat was collected and chemically analyzed for DM, CP and E.E according to (**AOAC 2002**).

2.8. Behavioral observations:

Ducks used in this study were observed as scan samples for 3 h/week per group and number of birds expressed as a percentage of total observed ducks. The following behavioural parameters were observed and measured throughout the experiment; eating, drinking, standing, walking, lying, huddling, preening, wing shaking, leg stretching and flying behaviour.

2.9. Statistical analyses:

The experimental data were evaluated using mixed model's procedure, *post hoc* comparisons were applied, whenever appropriate, using Duncan's test. All statistical procedures were performed using PASW statistics 18 (SPSS Inc., USA). Statistical significance was considered at $P \leq 0.05$.

3. Results and discussion:

3.1.Chemical examination and pH of silage:

The chemical composition and pH of silage before and after the fermentation process are shown in Table 2. Dry matter contents of silage with 2% organic acids was not affected by the fermentation process, when compared with the control, while crude protein content was significantly increased by addition of organic acids after fermentation process. In relation to fat content of silage addition of organic acids (2%) was decreased after fermentation when compared with control group. After fermentation process the crude fiber content was significantly decreased ($P \leq 0.05$) in groups supplemented by 2% organic acids followed by groups supplemented by 0.5 and 1% organic acids when compared with control group. In addition, the pH was reduced in silage supplemented with organic acids in both starter and grower diet after fermentation process.

The fermentation period is an important parameter because it determines the time needed and cost to produce the feed and to optimize the nutrient content (**Mohd-Setapar et al., 2012**). Also, Silages treated with experimental chemical preparations were characterized by higher dry matter concentrations which could have been associated with the limitation of development of certain groups of microorganisms and consequently, with smaller losses of nutrients. Increased dry matter concentrations in maize silages supplemented with chemical additives were also reported by (**Driehuis and Oude-Elfering 2000**).

Table 2. Analyzed chemical composition and pH of silage before and after fermentation (% of dry matter basis).

Parameters	Before ensilage	After ensilage			
	S	**S**	**S1**	**S2**	**S3**
Chemical composition, Starter diet					
DM	88.30±0.06[a]	86.53±0.09[b]	87.30±0.17[b]	87.57±0.03[b]	87.53±0.07[a]
CP	22.16±0.07[c]	22.16±0.07[b]	23.27±0.12[a]	23.67±0.03[b]	23.20±0.10[ab]
EE	2.51±0.02[a]	2.28±0.11[c]	2.31±0.04b	2.23±0.02[d]	2.20±0.00[d]
CF	3.26±0.03[a]	2.96±0.04[b]	2.86±0.03[c]	2.68±0.04[c]	2.50±0.03[d]
Chemical composition, grower diet					
DM	88.65±0.01[c]	86.65±0.01[bc]	86.97±0.38[a]	87.57±0.03[a]	87.40±0.06[a]
CP	16.61±0.02[c]	16.61±0.02[b]	18.17±0.09[a]	18.53±0.03[a]	18.50±0.15[c]
EE	2.95±0.01	2.71±0.13	2.43±0.01	2.82±0.01	3.19±0.73
CF	3.26±0.01[a]	3.26±0.01[a]	2.97±0.03[b]	2.60±0.06[c]	2.33±0.03[d]
pH, starter diet	5.53±0.09[a]	4.36±0.07[b]	4.30±09[b]	3.82±0.04[c]	3.68±0.04[cd]
pH, grower diet	5.63±0.03[a]	4.37±0.03[b]	3.73±0.07[c]	3.53±0.03[d]	3.47±0.07[de]

[a.b.c.d]Values with different superscripts within a row are significantly different ($P \leq 0.05$).

[1]Values are means ± standard error.

S= control (silage diet without additives), S1= control plus 0.5% organic acids, S2= control plus 1% organic acids, S3= control plus 2% organic acids,

Silages treated by organic acids were also characterized by higher protein concentrations probably due to limited growth of microorganisms leading to reduced intensity of protein proteolysis (**Selwet, 2008**). The addition of 105 cfu g–1 of LAB inoculants before ensiling produces an abundant amount of lactic acid during the early period of silage fermentation, which dramatically decreases the pH value (**Zhang Q et al. 2015**) and prevents the growth of aerobic microorganisms and decay. Improved acidic conditions, with decreased pH values would inhibit the growth of pathogenic bacteria that produce ammonia (**Flythe et al., 2006**). The increased lactic acid content of fermented feed improves feed quality and storability because it inhibits the growth of fungus, moulds and aerobic microbes (**Gollop et al., 2005**). It appears sensible to use chemical preservatives containing mixtures of propionic and formic acids since they improve the hygiene value of silages.

3.2.Growth performance:

Data related to growth performance of Mulard duckling is presented in table 3. Supplementation of organic acids to silage significantly ($P \leq 0.05$) increased weight gain.

Table 3. Effect of feeding silage with organic acids on growth performance of Mulard duck at the different stages (starter, grower and allover performance):

parameters	S	S1	S2	S3
Starter period (d 1 to 21)				
BW, g/bird	1190.8±0.66^{c}	1128±26.46^{d}	1224.6±5.56^{b}	1239.8±0.8^{a}
BWG, g/bird	1130.8±0.66^{c}	1068±26.46^{d}	1164.6±5.56^{b}	1179.8±0.8^{a}
FCR	1.578±0.01^{a}	1.516±0.01^{b}	1.524±0.01^{b}	1.516±0.01^{b}
FI, g/bird	1781.8±4.29^{a}	1619.2±32.74^{b}	1773.6±4.57a	1787±3.16^{a}
Grower period (d 22 to 42)				
BW, g/bird	3051.4±7.47^{d}	3211.4±6.24^{b}	3184.8±3.15^{c}	3406.4±10.09^{a}
BWG, g/bird	1860.8±7.09^{d}	2083.4±24.10^{b}	1960.4±3.27^{c}	2167±10.73^{a}
FCR	2.526±0.032^{a}	2.194±0.09^{b}	2.15±0.013^{b}	2.03±0.02^{c}
FI, g/bird	4698.4±43.91^{a}	4574.6±57.49^{b}	4217±26.34^{d}	4400.4±30.37^{c}
Allover period				
Feed intake, g/bird	6479.8±45.32^{a}	6193.6±26.98^{b}	5990.4±26.23^{c}	6187.4±30.07^{b}
Body weight gain, g/bird	2991.4±7.47^{d}	3151.4±6.24^{b}	3124.8±3.15^{c}	3346.4±10.09^{a}
FCR	2.166±0.02^{a}	1.966±0.01^{b}	1.916±0.01^{c}	1.85±0.01^{d}
Protein efficiency ratio	2.214±0.02^{c}	2.442±0.01^{b}	2.49±0.01^{b}	2.59±0.02^{a}

[a,b,c,d]Values with different superscripts within a row are significantly different ($P \leq 0.05$). [1]Values are means ± standard error. S= control (silage diet without additives), S1= control plus 0.5% organic acids, S2= control plus 1% organic acids, S3= control plus 2% organic acids,

The feed conversion ratio and protein efficiency ratio for ducklings received silage with higher level of organic acid has improved. In relation to total feed intake, the lowered feed intake was observed in groups fed on silage supplemented by 2% organic acids, when compared with the control group.

Improved BWG was probably due to the beneficial effects of OA on the gut microflora, which improved the availability of nutrient to the host animal. Also, the improvement in BWG can be a result of the influence of OA on the integrity of microbial cell membrane. This improvement also can be the result of OA interference with energy metabolism and nutrient transport (**Ricke,2003; Adil et al., 2010**). The use of organic acids has been reported to protect the young chicks by competitive exclusion (**La Ragione et al., 2003**), enhancement of nutrient utilization, growth and feed conversion efficiency (**Denli et al., 2003**).

3.3. Digestibility:

Parameters related to dry matter, crude protein, crude fiber digestibility are presented in table 4. Addition of organic acids by 2% caused a significant increased ($P \leq 0.05$) in dry matter and crude protein digestibility when compared with control group. Also, the crude fiber digestibility was increased with increasing level of organic acids.

Table 4.Effect of feeding silage with organic acids on digestibility% of Mulard duckling (42 d):

Parameters	S	S1	S2	S3
Dry matter	74.77±0.09^{c}	75.90±0.06^{b}	76.07±0.07^{b}	76.43±0.12^{a}
Crude protein	65.63±0.12^{c}	67.53±0.15^{b}	67.63±0.09^{b}	68.97±0.12^{a}
Crude fiber	39.40±0.06^{b}	39.73±0.17^{b}	41.70±0.06^{a}	41.73±0.09^{a}

[a,b,c,d]Values with different superscripts within a row are significantly different ($P \leq 0.05$). [1]Values are means ± standard error. S= control (silage diet without additives), S1= control plus 0.5% organic acids, S2= control plus 1% organic acids, S3= control plus 2% organic acids.

The positive effect of organic acids on digestion was related to a slower passage of feed in the intestinal tract, a better absorption of the necessary nutrients and less wet droppings. Our results agree also with that of, (**Ghazala et al. 2011**) reported that 0.5% dietary supplementation of either fumaric improved both ME and nutrient digestibility, like, crude protein (CP), ether extract (EE), crude fiber (CF) and nitrogen-free extract (NFE) of broiler diets.

The increase in crude protein digestibility coefficient may be attributed to that organic acids raised gastric proteolysis and improved protein and amino acids digestibility as reported by (**Samanta et al. 2010**). It was thought that the organic acids supplementation lowers the pH of the chime which might increase the pepsin activity and thus enhance the digestibility of protein (**Afsharmanesh and Porreza, 2005**). Similarly, (**Ao et al. 2009**) observed that 2% citric acid in the broiler diet also increased the retention of DM, CP and neutral detergent fiber. In addition, (**Samanta et al. 2010**) reported that organic acids improve gastric proteolysis as well as the digestibility of proteins and amino acids, and so improve musculature of broilers.

4.3. Carcass characteristics and meat composition:

Data of carcass measurement, length of different parts of small intestine and chemical composition of meat are presented in table 5. The highest carcass weight and breast yield were in groups fed on silage supplemented by 2% and 1% organic acids followed by group fed on silage supplemented by 0.5% organic acids when compared with the control group. Inclusion of organic acids significantly increased the weight of digestive organs as small intestine and gizzard. The length of duodenum was not affected by organic acids supplementation to silage however, the jejunum and ileum length were significantly increased by 2% addition of organic acids. Also, dietary addition of organic acids by 1 and 2% were increased the small intestine length. The groups supplemented by organic acids significantly increased breast and thigh dry matter and crude protein content. In addition, inclusion of 1and 2% organics acids increased ($P \leq 0.05$) breast fat content. (**Hossain and Nargis, 2016**) stated that addition of organic acids blend composed of propionic acid, formic acid, and 2-hydroxy-4-methylthio-butanoic acid and acid improved edible organs weight especially gizzard and heart and increased meat yield. These results were in agreement with those of (**Nour Mohammadi et al., 2011**).The impact of lactic acid-fermented feed resembles the effects of probiotics, suggesting that using lactic acid as a supplement could improve performance and increase small intestine weight in broilers (**Adil et al., 2010**).The result coincides with the findings of (**Aksu etal. 2007**), who reported that carcass, thigh, and breast weights of broiler scan be improved by organic acid supplementation at 4g/kg of feed. (**Chowdhury et al. 2009**) and observed higher carcass weight in broilers receiving organic acids with antibiotics. However, previous studies have shown that carcass, breast and thigh yields are not affected by dietary butyric acid (**Mahdavi andTorki, 2009**), citric acid (**Haque et al., 2010**), formic acid (**García et al., 2007**) and propionic acid (**Khosravi et al., 2012**) supplementation. In a recent study, (**Saki et al., 2012**) reported an increase in breast and thigh meat yields at 21 days, whereas the effect could not be observed at 42 days. Increased dressing yield upon organic acid supplementation could be attributed to higher live weight. However, (**Islam et al., 2008**) found no differences in head, skin, giblet, and visceral relative weights in broilers fed acetic acid or citric acid. (**Saki et al., 2012**) observed higher relative liver and heart weights as well as lower gizzard weight at 21days, whereas the effect was not seen at 42 days. In addition, dressing percentage improved, and breast and thigh weight increased linearly ($P < .01$) with increasing dose of organic acids moreover, protein content of meat increased with organic acids supplementation (**Samanta et al., 2010**).

Table 5. Effect of feeding silage with organic acids on carcass characteristics and meat chemical composition of Mulard duck at slaughter (d 42).

Parameters	S	S1	S2	S3
Carcass characteristics				
Carcass weight, g	2375.33±5.84^{b}	2574.33±5.49^{a}	2571.33±7.22^{a}	2585.00±2.00^{a}
Breast weight, g	720.00±2.52^{b}	747.67±4.26^{a}	755.33±2.91^{a}	751.67±4.41^{a}
Breast meat yield g/kg	516.33±±4.67^{c}	546.33±4.10^{b}	566.33±3.18^{b}	565.67±1.45^{a}
Weight of organs				
Small intestine, g	124.73±0.09^{b}	125.87±0.15^{a}	126.23±0.27^{a}	126.37±0.26^{a}
Proventriculus, g	9.40±0.12^{b}	9.63±0.09^{b}	10.47±0.15^{a}	10.70±0.12^{a}
Gizzard, g	88.53±0.09^{c}	89.20±0.06^{b}	89.57±0.09^{ab}	89.67±0.15^{a}
Liver, g	99.70±0.10^{b}	99.93±0.15^{b}	100.00±0.12a^{b}	100.43±0.09^{a}
Length of small intestine				
Duodenum	35.67±0.67	35.00±0.58	36.33±0.88	36.67±0.33
Jejunum	84.33±0.88^{c}	93.67±1.45^{b}	97.33±0.88^{ab}	98.33±0.88^{a}
Illum	50.67±1.20^{b}	53.00±0.58^{b}	56.33±0.88^{a}	55.33±1.86^{ab}
Cecum	15.67±0.88^{b}	16.67±0.33^{b}	21.00±0.58^{a}	20.33±0.88^{b}
Rectum	7.33±0.33^{ab}	7.00±0.58^{ab}	6.33±0.33^{b}	9.00±0.58^{a}
Small intestine	193.67±0.88^{c}	205.33±0.67^{b}	217.33±0.88^{a}	219.67±1.33^{a}
Carcass chemical analysis %				
Breast, dry matter	26.13±0.09^{b}	26.50±0.06^{a}	26.70±0.10^{a}	26.77±0.09^{a}
Thigh, dry matter	26.77±0.07^{b}	27.43±0.07^{a}	27.57±0.03^{a}	27.87±0.07^{a}
Breast, crude protein	70.63±0.15^{c}	71.90±0.06^{b}	72.17±0.09^{ab}	72.47±0.09^{a}
Thigh crude protein	68.53±0.15^{b}	69.47±0.03^{a}	69.57±0.09^{a}	69.50±0.15^{a}
Breast ether extract	11.80±0.10^{b}	11.73±0.12^{b}	12.43±0.07^{a}	12.50±0.15^{a}
Thigh ether extract	17.33±0.13	17.30±0.15	17.43±0.09	17.42±0.09

[a.b.c.d]Values with different superscripts within a row are significantly different ($P \leq 0.05$). [1]Values are means ± standard error. S= control (silage diet without additives), S1= control plus 0.5% organic acids, S2= control plus 1% organic acids, S3= control plus 2% organic acids,

5.3. Behavioral observation:

Data related to behavioral observation are shown in Table 6. As behavior is a good indicator for the assessment of the welfare of birds our results revealed that the eating and drinking frequencies were the highest in control silage group and group supplemented with 0.5% OAs when compared with silage supplemented groups with 1 and 2% OAs.

Table 6. Effect of feeding silage with organic acids on behavioral observations of mulard duck.

Parameters	S	S1	S2	S3
Eating	113.11 ± 2.66	95.77 ± 0.79	88.66 ± 0.83	79.77 ± 0.79
Drinking	58.88 ± 0.44	45.22 ± 0.72	35.89 ± 0.11	32.55 ± 0.94
Standing	14.00 ± 0.88	16.66 ± 0.19	28.89 ± 0.40	40.55 ± 0.39
Walking	13.33 ± 1.01	17.99 ± 0.33	19.67 ± 0.57	24.66 ± 1.20
Lying	35.66 ± 2.16	41.11 ± 0.58	42.22 ± 0.72	48.44 ± 3.08
Huddling	71.67 ± 0.00	75.33 ± 1.57	80.78 ± 9.11	81.33 ± 11.23
Preening	18.05 ± 0.28	18.05 ± 0.28	18.28 ± 0.29	18.39 ± 0. 43
Wing shaking	16.40 ± 0.40	16.50 ± 0.35	16.73 ± 0.29	17.22 ± 0.20
Leg stretching	6.56 ± 0.11b	6.72 ± 0.24b	7.61 ± 0.39b	8.71 ± 0.29a
Flying	8.55 ± 0.53	9.22 ± 0.09	9.50 ± 0.6	9.83 ± 0.87

[a.b.c.d]Values with different superscripts within a row are significantly different ($P \leq 0.05$). [1]Values are means ± standard error. S= control (silage diet without additives), S1= control plus 0.5% organic acids, S2= control plus 1% organic acids, S3= control plus 2% organic acids,

The results of the present study are in line with those obtained by (**Sheikh et al., 2011**, **Ghazalah et al., 2011**, **Hassan et al., 2016**) and (**Hossain and Nargis 2016**) who indicated that dietary supplementation of organic acids improved performance of broiler chickens as compared to the un- supplemented group. The improved body weight gain of duckling, reported herein, is probably due to the beneficial effect of organic acids on the gut flora. Additionally, organic acids feeding were reported to have several beneficial effects on feed conversion ratio, growth performance and enhancing mineral absorption (**Král et al., 2011, Gálik and Rolinec, 2011 and Petruška et al., 2012**). In addition, (**Symeon et al. 2010**) stated that feeding and drinking were highly and significantly related in birds. The comfort behavior patterns are an indicator of animal welfare (**Jensen, 2002**). The standing behaviors were significantly increased in S2 and S3 in comparison with other groups. It was more prominent that increasing S3 in the diet significantly ($P < 0.05$) increased the frequency of walking behavior. In addition, organic acid enhanced the activities of preening, wing shaking and flying especially S3, S2 due to The inclusion of organic acids in the poultry feed has been appeared to enhance poultry performance (**Halen and Christian, 2010, Talebi et al., 2010; Hassan et al., 2016**)

4. Conclusion

This study concluded that addition of organic acids to anaerobically fermented feed had a positive impact on silage quality in relation to storage period and under summer condition, more over it enhances the duck's productive performance and nutrient digestibility. Finally, our data recommended that addition of 2% organic acid mixture during ensilage appears to be a very effective method for improving silage stability during duck feeding period and offers best quality silage for ducks based on feed utilization.

5. References:

Adil, S., Banday, T., Bhat, G.A., Mir, M.S. and Rehman, M., (2010). Effect of dietary supplementation of organic acids on performance, intestinal histomorphology, and serum biochemistry of broiler chicken. *Veterinary medicine international*.

Afsharmanesh, M. and Pourreza, J., (2005). Effects of calcium, citric acid, ascorbic acid, vitamin D 3 on the efficacy of microbial phytase in broiler starters fed wheat-based diets I. Performance, bone mineralization and ileal digestibility. International journal of poultry science.

Akinola, O.S., A.O. Onakomaiya, J.A. Agunbiade and A.O. Oso, (2015). Growth performance, apparent nutrient digestibility, intestinal morphology and carcass traits of broiler chickens fed dry, wet and fermented-wet feed. Livest. Sci., 177: 103-109

Aksu, T., 2007. The response of broilers to dietary organic acid mixture. Indian Veterinary Journal, 84, pp.385-387.

Allaily, N.R. and Ridwan, R., (2011). The quality of complete ration silage use traditional local feed materials. Journal Agripet, 11(2).

AOAC. (2002). Official Methods of Amlysis. 17th Edn. Association of Official Analytical Chemists, Arlington, VA,.

Ao, T., Cantor, A.H., Pescatore, A.J., Ford, M.J., Pierce, J.L. and Dawson, K.A., (2009). Effect of enzyme supplementation and acidification of diets on nutrient digestibility and growth performance of broiler chicks. PoultryScience, 88(1), pp.111-117.

Chowdhury, R., Islam, K.M.S., Khan, M.J., Karim, M.R., Haque, M.N., Khatun, M., Pesti, G.M., (2009). Effect of citric acid, avilamycin, and their combination on the performance, tibia ash, and immune status of broilers. PoultryScience 88, 1616-1622.

Christian, L., (2015). Effect of dietary sodium diformate on growth performance, nutrient digestibility, gut health and profitability in broilers. In 20th European Symposium on Poultry Nutrition.

Denli, M., Okan, F. and Celik, K., (2003). Effect of dietary probiotic, organic acid and antibiotic supplementation to diets on broiler performance and carcass yield. PakistanJournalofNutrition, 2(2), pp.89-91.

Desai, D., Patwardhan, D. and Ranade, A., (2007). Acidifiers in poultry diets and poultry production. Acidifiers in Animal Nutrition: A Guide for Feed Preservation and Acidification to Promote Animal Performance. Nottingham UniversityPress, Nottingham, UK, pp.63-69.

Driehuis, F. and Elferink, S.O., (2000). The impact of the quality of silage on animal health and food safety: a review. Veterinary Quarterly, 22(4), pp.212-216.

Filya, I., Sucu, E. and Canbolat, O., (2004). Researches on Using Organic Acids in the Silage Fermentation. UludagUni. Agric. Fak, 18(2), pp.35-45.

Flythe, M.D and J.B. Russell, (2006). Fermentation acids inhibit amino acid deamination by Clostridium sporogenes MD1 via a mechanism involving a decline in intracellular glutamate rather than proton motive force. Microbiology, 152: 2619-2624.

Gálik, B.; and Rolinec, M., (2011). The effect of phytogenic feed additives on the performance of non-ruminants, Proc. International Ph.D. workshop on welfare, biotechnology and quality of animal production, Nitra, Slovak University of Agriculture,

Garcia, V., Catala-Gregori, P., Hernandez, F., Megias, M.D. and Madrid, J., (2007). Effect of formic acid and plant extracts on growth, nutrient digestibility, intestine mucosa morphology, and meat yield of broilers. Journal of Applied Poultry Research, 16(4), pp. 555-562.

Ghazalah, A. A.; Atta, A.M.; Elkloub, K.; Moustafa, M. EL. and Riry, F.H. Shata (2011). Effect of dietary supplementation of organic acids on performance, nutrients digestibility and health of broiler chicks. Int. J. Poult. Sci., 10: 176-184.

Gollop, N., V. Zakin and Z.G. Weinberg, (2005). Antibacterial activity of lactic acid bacteria included in inoculants for silage and in silages treated with these inoculants. J. Applied Microbiol., 98: 662-666.

Grashorn, M.A., (2010): Use of phytobiotics in broiler nutrition – an alternative to in feed antibiotics? J. Anim. FeedSci. 19, 338-347.

Halen,B., and Chtistian, L., (2010). Performance enhancement through the use of diformates in broiler. http://www.chickoholic. Wordpress.com.

Haque, M.N., Islam, K.M., Akbar, M.A., Chowdhury, R., Khatun, M., Karim, M.R. and Kemppainen, B.W., (2010). Effect of dietary citric acid, flavomycin and their combination on the performance, tibia ash and immune status of broiler. Canadian journalof animal science, 90(1), pp.57-63.

Hassan; Rasha, M. I.; Mosaad, G. M. M.; and Abd-Ellah, A. M., (2016). Effect of feeding citric acid on performance of broiler ducks fed different protein levels. J.adv. vet. Res., 6:18-26.

Hossain, M.E. and Nargis, F., (2016). Supplementation of organic acid blends in water improves growth, meat yield, dressing parameters and bone development of broilers. Bangladesh Journal of Animal Science, 45(1), pp.7-18.

Huyghebaert, G., Ducatelle, R. and Van Immerseel, F., (2011). An update on alternatives to antimicrobial growth promoters for broilers. TheVeterinaryJournal, 187(2), pp.182-188.

Islam, M.Z., Khandaker, Z.H., Chowdhury, S.D. and Islam, K.M.S., (2008). Effect of citric acid and acetic acid on the performance of broilers. J. Bangladesh Agri. Univ, 2, pp.315-320.

Jensen P. (2002). The etiology of domestic animals: an introductory text. CABI;.

Khosravi, A., Boldaji, F., Dastar, B. and Hasani, S., (2012). Comparison of broiler performance and carcass parameters when fed diets containing a probiotic, an organic acid or antibiotic growth promoter. Asian. J. Anim. Vet. Adv, 7, pp.318-325.

Král, M.; Angelovičová, M.; Mrázová, Ľ.; Tkáčová, J.; Kliment, M., (2011). Probiotic and acetic acid of broiler chickens performance. Sci. Papers Ani. Sci. Biot., 44, 149-152

La Ragione, R.M. and Woodward, M.J., (2003). Competitive exclusion by Bacillus subtilis spores of Salmonella enterica serotype Enteritidis and Clostridium perfringens in young chickens. Veterinarymicrobiology, 94(3), pp.245-256.

Mahdavi, R. and Torki, M., (2009). Study on Usage Period of Dietary Protected Butyric Acid on Performance. Journal of Animal and Veterinary Advances, 8(9), pp.1702-1709.

Marquardt, R.R., (1983). A simple spectrophotometric method for the direct determination of uric acid in avian excreta. Poultry Science 62, 2106 -2108.

McDonald, P., (2002). Animal nutrition. 7th edn. Pearson education

Merryana, F.O., (2007). Performance and histopathology intestinal of broiler chickens fed by silage and treat by Salmonella typhimurium. M.S. Thesis, InstitutPertanian Bogor, Bogor, Indonesia, **(In Indonesian).**

Milbradt, E.L., A.S. Okamoto, J.C.Z. Rodrigues, E.A. Garcia, C. Sanfelice, L.P. Centenaro and R.L. Andreatti Filho, (2014). Use of organic acids and competitive exclusion product as an alternative to antibiotic as a growth promoter in the raising of commercial Turkeys. Poult. Sci., 93: 1855-1861.

Mohd-Setapar, S.H., N. Abd-Talib and R. Aziz, (2012). Review on crucial parameters of silage quality. APCBEE Procedia, 3: 99-103.

NRC, (1994). Nutrient requirements of poultry. National Academy Press Washington, DC.

Naseri KG, Rahimi S, Khaki P. (**2012**). Comparison of the effects of probiotic, organic acid and medicinal plant on Campylobacter jejuni challenged broiler chickens. J Agric Sci Technol;14:1485-96

Nour Mohammadi, R., Hosseini, S.M., Saraee, H. and Arab, A., (2011). Plasma thyroid hormone concentrations and pH values of some GI-tract segments of broilers fed on different dietary citric acid and microbial phytase levels. Am. J. Anim. Vet. Sci, 6, pp.1-6.

Park, K.W., Rhee, A.R., Um, J.S. and Paik, I.K., (2009). Effect of dietary available phosphorus and organic acids on the performance and egg quality of laying hens. JournalofAppliedPoultryResearch, 18(3), pp.598-604.

Petruška, P.; Tušimová, E.; Kalafová, A.; Haščík, P.; Kačániová, M.; Kolesárová, A.; and Capcarová, M., (2012). Effect of propolis in chicken diet on selected parameters of mineral profile. J. Micr. Biot. FoodSci., 1: 1090-1097

Ricke, S.C., (2003). Perspectives on the use of organic acids and short chain fatty acids as antimicrobials. Poultry science, 82(4), pp.632-639.

Saki ,A.A., Harcini, R.N., Rahmatnejad, E. and Salary,J.(2012). Herbal additives and organic acids as antibiotic alternatives in broiler chickens diet for organic production. Afric. J. of Biotech,11:2139-2145.

Samanta, S., Haldar, S. and Ghosh, T.K., (2010). Comparative efficacy of an organic acid blend and bacitracin methylene disalicylate as growth promoters in broiler chickens: effects on performance, gut histology, and small intestinal milieu. Veterinary medicine international, 2010.

Samli, H.E., Sirci, G., Lorenzo Bermejo, J., Koc, F., AgmaOkur, A. and Senkoylu, N., (2008). Effect of addition of a commercial organic acid mixture on feed microbiology according to duration and conditions of storage. Acta AgriculturaeScandSection A, 58(4), pp.186-190.

Selwet, M., (2008). Effect of organic acids on numbers of yeasts and mould fungi and aerobic stability in the silage of corn. Polishjournalofveterinary sciences, 11(2), p.119.\

Sheikh, A.; Banday, T.; Bhat, G. A.; Salahuddin, M.; Raquib, M.; and Shanaz, S. (2011). Response of broiler chicken to dietary supplementation of organic acids. J. Cen. Eur. Agri.,12: 498-508.

Short, F.; Wiseman, J.; Boorman, K., (1999): Application of a method to determine ileal digestibility in broilers of amino acids in wheat. Animal Feed Science and Technology 79, 195 – 209.

Swiątkiewicz, S., Koreleski, J. and Arczewska, A., (2010). Effect of organic acids and prebiotics on bone quality in laying hens fed diets with two levels of calcium and phosphorus. Acta Veterinaria Brno, 79(2), pp.185-193.diets supplemented with prebiotics and organic acid. Czech. J. Anim. Sci. 55(7), 294-306.

Symeon GK, Zintilas C, Demiris N, Bizelis IA, Deligeorgis SG (2010): Effects of oregano essential oil dietary supplementation on the feeding and drinking behavior as well as the activity of broilers. Int J Poult Sci; 9 (4):401e5.

Talebi, E.; Zarei, A.; and Abolfathi, M. E., (2010). Influence of three different organic acids on broiler performance. Asian, J. Poult.Sci.,4:7-11.

Tien, D.T.M., Tran, N.T.B., Hang, B.P.T. and Preston, T.R., (2014). Performance of common ducks fed an ensiled mixture of banana pseudo-stem and taro (Colocasiaesculenta) foliage as a supplement to restricted rice bran and ad libitum fresh duckweed. LivestockResearchfor Rural Development, 26.

Wagner, D.; Furrow, R.; Bradley, B., (1983): Subchronic toxicity of monensin in broiler chickens. *Veterinary pathology* **20**, 353-359.

Zhang J., Guo G., Chen L., Li J., Yuan X., Yu C., Shimojo M., Shao T. (2015). Effect of applying lactic acid bacteria and propionic acid on fermentation quality and aerobic stability of oats- common vetch mixed silage on the Tibetan plateau. Animal Science Journal, 86, 595–602.

المخلص العربى

تحسين جودة السيلاج و أداء وسلوكيات بط المولارد المغذاة علي علائق السيلاج المضاف إليها الحموض العضوية

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الهدف من هذة الدراسة هو تقييم اضافة مستويات مختلفة من الحموض العضوية على جودة السيلاج و النمو و الهضم و صفات الذبيحة و سلوكيات صغار البط المولارد المغذاة على الغذاء المتخمر لا هوائيا. تم تقسيم عدد 200 طائر من البط المولارد عشوائيا الى اربعة مجاميع (5 مكررات لكل مجموعة) و تم تكوين الاربعة علائق كالاتى: 1- العليقة الضابطة (سيلاج بدون اضافات). 2- العليقة الضابطة مضاف اليها 0.5 % من الحموض العضوية. 3- العليقة الضابطة مضاف اليها 01 % من الحموض العضوية. 4- العليقة الضابطة مضاف اليها 2 % من الحموض العضوية. لتغذية مجاميع البط المختلفة اثناء فترة البادى و الناهى. اظهرت النتائج ان اضافة الحموض العضوية تقلل من فقد المواد الغذائية اثناء التخمر وادت الى نقص عدد الكائنات الدقيقة الضارة بالسيلاج. بالاضافة الى ان تركيز حمض الاكتيك و البروبيونيك قد ذاد و بالعكس فان حمض البيوتريك قد قل مع ذيادة مستوى الحموض العضوية للسيلاج. وقد اوضحت النتائج الخاصة بالنمو ان ذيادة مستوى الحموض العضوية الى 2% قد حقق اعلى معدل زيادة فى الوزن مقارنة بباقى المجاميع، بالاضافة لذلك فإن اضافة 1 و 2% من السيلاج قد حسن من معدل التحويل الغذائى و مدى الاستفادة من البروتين للبط. قد وجد ان معامل الهضم قد تحسن مع ذيادة مستوى الحموض العضوية للسيلاج. وقد ادت اضافة مخلوط الحموض العضوية الى السيلاج الى تاثير ايجابى على الوزن الصافى للذبيحة و كذلك تصافى لحوم الصدر و الفخذ. وكذلك اوضحت النتائج ان محتوى البروتين فى لحوم الفخذ و الصدر قد أرتفع اما بالنسبة للدهون فقد قلت خاصة فى لحوم الصدر. وبملاحظة سلوك الطيور قد اتضح ان اعلى معدلات اقبالا على الغذاء كانت فى المجاميع المغذاة على عليقة السيلاج الضابطة و عليقة السيلاج المضاف اليها 0.5% حموض عضوية مقارنة بمجاميع السيلاج المضاف اليها 1 و 2% من الاحماض العضوية. بالاضافة لذلك ان البط المغذى على 2% من الحموض العضوية كان اكثرنشاطا مقارنة بالمجاميع الاخرى. ونستنتج من البحث ان اضافة الحموض العضوية الى السيلاج قد يساعد علي تحسين قيمتة الغذائية و كذلك رفع مستوى اداء بط المولارد.