EFFECT OF FERMENTABLE LIQUID DIET BASED ON TOMATO SILAGE ON THE PERFORMANCE OF GROWING FINISHING PIGS

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SUMMARY

This study was performed to evaluate the use of tomato silage as part of fermentable liquid diet for growing finishing pigs. Thirty two crossbreed (Duroc × York) male pigs of 27 ±3 days age and 8.4 ±1.3kg body weight (BW) were randomly assigned to one of two diets: diet 1, basal diet with 30% (DM basis) of tomato silage (TS); and diet 2, basal diet with 30% (DM basis) of wet brewers grains (WBG) as control. Growth and carcass characteristics were measured. The average daily weight gain (ADG) was improved (P<0.05) in pigs fed TS diet at 0-40 and 40-80 days feeding periods. Pigs on TS diet grew faster (P<0.05) than pigs on WBG diet. Carcass characteristics were unaffected (P>0.05) by TS addition. It is concluded that tomato silage can be added at 30% DM basis in fermentable liquid diets of grow-finishing pigs, because this diet improved growth performance without affect carcass characteristics.

EFECTO DE LA ALIMENTACIÓN DE CERDOS EN CRECIMIENTO Y FINALIZACIÓN CON DIETAS LÍQUIDAS FERMENTABLES A BASE DE ENSILAJE DE TOMATE

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RESUMEN

Este estudio fue conducido para evaluar el uso de ensilaje de tomate como parte de dietas líquidas fermentadas para cerdos en crecimiento y finalización. Treinta y dos cerdos machos (Duroc × York) de 27 ±3 días de edad y con un peso inicial de 8.4 ±1.3kg de peso vivo (PV) fueron asignados aleatoriamente a una de dos dietas experimentales: dieta 1, una dieta basal con 30% (en base a MS) de ensilaje de tomate (ET); y la dieta 2, una dieta basal con 30% (en base a MS) con bagazo de cervecería húmedo (BCH) como control. Se evaluaron los parámetros productivos y las características de la canal. La ganancia diaria de peso (GDP) se incrementó (P<0.05) en los cerdos alimentados con ET en los periodos de alimentación de 0-40 y 40-80 días. Los cerdos alimentados con la dieta ET crecieron más rápido (P<0.05) que los cerdos alimentados con la dieta BCH. Las características de la canal no fueron afectadas (P>0.05) por la adición de ET. Se concluye que el ensilaje de tomate puede ser incluido en un 30% de las dietas líquidas fermentadas de cerdos en crecimiento-finalización, debido a que esta dieta mejora los parámetros productivos sin afectar las características de la canal.

Introduction

The traditional swine feeding is based on soybean meal, and corn or sorghum grains, which have had price increases becoming expensive in recent times. The average price for cereals during 2000 to 2005 was USD204/ton; however, for 2006 to 2010 the price increased up to USD417/ton (FAOSTAT, 2013). Therefore, the pork industry is including now agro industrial byproducts as a strategy to maintain its profitability (Aguilera-Soto et al., 2009). Some byproducts have a high level of humidity and are therefore frequently dried before being stored or transported; nevertheless, due to environmental concerns and the additional expenses from fuel cost for drying, the use of wet byproducts is becoming popular among farmers. Moist feed are usually perishable due to aerobic decay, which produces nutrient loss and contamination with microorganism and their toxins. Thus, fermentation is an option for storage of wet byproducts.

Fermentable liquid diets (FLD) are used as an option to include wet byproducts on swine diets (Jensen and Mikelsen, 1998). The FLD enhances swine health by dropping stomach pH, increasing lactic acid concentration and decreasing populations of...
Este estudo foi conduzido para avaliar o uso de ensilagem de tomate como parte de dietas líquidas fermentadas para porcos em cresciamento e finalização. Trinta e dois porcos machos (Duroc × York) de 27 ± 3 dias de idade e com um peso inicial de 8,4 ± 1,3kg de peso vivo (PV) foram designados aleatoriamente a uma de duas dietas experimentais: dieta 1, uma dieta basal com 30% (com base a MS) de ensilagem de tomate (ET); e a dieta 2, uma dieta basal com 30% (com base a MS) com bagaço de cervejaria úmido (BCU) como controle. Avaliaram-se os parâmetros produtivos e as características da trincheira. O ganho diário de peso (GDP) se incrementou (P<0,05) nos porcos alimentados com ET nos períodos de alimentação de 0-40 e 40-80 dias. Os porcos alimentados com a dieta ET cresceram mais rápido (P<0,05) que os porcos alimentados com a dieta BCU. As características da trincheira não foram afetadas (P>0,05) pela adição de ET. Conclui-se que a ensilagem de tomate pode ser incluída em um 30% das dietas líquidas fermentadas de porcos em crescimento-finalização, devido a que esta dieta melhora os parâmetros produtivos sem afetar as características da trincheira.
FERMENTABLE DIETS BASED ON 30% OF TOMATO SILAGE (TS) OR WET BREWER`S GRAIN (WBG)

TABLE I
INGREDIENT AND CHEMICAL COMPOSITION OF THE FERMENTABLE LIQUID DIETS WITH TOMATO SILAGE (TS) OR WET BREWER`S GRAIN (WBG)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>TS</th>
<th>WBG</th>
<th>SEM</th>
<th>P&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet brewers grain, g·kg⁻¹</td>
<td>0.0</td>
<td>300</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Tomato silage, g·kg⁻¹</td>
<td>300</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Corn grain, g·kg⁻¹</td>
<td>400</td>
<td>400</td>
<td>460</td>
<td>460</td>
</tr>
<tr>
<td>Soybean meal, g·kg⁻¹</td>
<td>250</td>
<td>200</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Fish meal, g·kg⁻¹</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Premix, g·kg⁻¹</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Calcium carbonate g·kg⁻¹</td>
<td>0.0</td>
<td>300</td>
<td>0.0</td>
<td>300</td>
</tr>
<tr>
<td>Chemical composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry matter, %</td>
<td>52.7</td>
<td>51.0</td>
<td>49.9</td>
<td>50.4</td>
</tr>
<tr>
<td>Ash, %</td>
<td>4.1</td>
<td>4.4</td>
<td>4.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Crude protein, %</td>
<td>23.5</td>
<td>23.3</td>
<td>20.5</td>
<td>20.4</td>
</tr>
<tr>
<td>Neutral detergent fiber, %</td>
<td>18.1</td>
<td>19.5</td>
<td>16.3</td>
<td>18.6</td>
</tr>
<tr>
<td>Acid detergent fiber, %</td>
<td>7.2</td>
<td>8.4</td>
<td>7.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Crude fiber, %</td>
<td>5.8</td>
<td>6.2</td>
<td>5.6</td>
<td>6.1</td>
</tr>
<tr>
<td>Ether extract, %</td>
<td>2.4</td>
<td>2.4</td>
<td>2.6</td>
<td>2.9</td>
</tr>
</tbody>
</table>

WBG: diet served as control.

Statistical analysis
Data were analyzed by using one-way analyses of variance applying the GLM procedure of SAS (2000). Growth performance variables were adjusted for initial weight by covariance analyses. Means were separated by means of the Tukey multiple range test at P<0.05.

Results and Discussion
Weight of pigs differ (P<0.05) among treatments at all feeding periods (Table II). Pigs fed TS diet were heavier (P<0.05) than pigs consuming the control diet (11, 16 and 10% at post-weaning, growing and finishing phases, respectively). Pigs fed TS diet were 9.8% heavier (P<0.02) at 130 days than pigs fed control diet. The average daily gain (ADG) in weight was greater (P<0.01) for pigs fed TS than for pigs fed WBG diet, at the post-weaning (423 vs 360 g/day) and growing (763 vs 633 g/day) feeding phases; however, it was similar (P=0.46) at the finishing phase, with gains of 810 and 790 g/day for pigs fed TS and WBG diets, respectively.

In agreement with the present results, Caluya et al. (2000) added 6% (on DM basis) of tomato pomace to fattening commercial diets and reported an increase on the ADG and final weight of pigs on the tomato feeding diet. In turn, Cilev et al. (2007) substituted corn grain with vegetable and fruit by-products in growing pig diets, and reported that during the initial feeding period (50 days), pigs on the tomato diet were lighter than controls; however, after 100 days of fattening the final weight was similar (P>0.05) when fed 0% (96.2kg), 2% (98kg), or 3% (99.5kg) of tomato pomace in the diet.

On the other hand, Imamidou et al. (1999) added 4 or 8% of dry tomato pulp to swine diets and reported lower (P>0.05) nutrient digestibility (DM, OM, CP and CF) on animals fed 8% of tomato pulp. Fondavila et al. (1994) added 20% of tomato pomace to diets for growing lambs and observed similar ADG (P>0.05) in comparison to soybean meal diets (311 and 333 g/day, respectively). In addition, Abdullahzadeh (2012) reported similar (P>0.05) final weights for goat kids fed diets with 0, 10, 20 and 30% dried tomato pomace. Similarly, Barbier-Sanz (1993) added 0, 10, 20, 30 and 40% of wet tomato pomace to diets for feedlot steers, and reported similar (P>0.05) performance data among the experimental treatments. However, Yuangklang et al. (2010) reported a reduction in the final weight of steers as dried tomato pomace was increased (3.2, 8.0, or 11.2%) in diets.

Pigs on TS diet had a greater (P<0.01) dry matter intake (DMI) than pigs on a WBG diet at all feeding periods (Table II). The difference between treatments was 5% in the post-weaning phase, and 9% in the subsequent feeding phases. Cilev et al. (2007) reported reduction of DMI of pigs when tomato pomace was included (at 2 or 3%) in the diets. Yitbarek et al. (2013) observed similar DMI (P>0.05) among growing chicks fed diets with 0, 5, 10, 15 or 20% of dried tomato pomace. However, Lira et al. (2010), who included 0, 5, 10, 15 and 20% of tomato waste on broiler diets, reported that DMI was reduced as tomato increased in the diet in the initial 1 to 7 days of feeding, but DMI increased at days 36 to 42 of fattening. Moreover, feed efficiency followed the same pattern as ADG. In the present study, pigs on TS diet required fewer days (P<0.01) to reach target weight (142 vs 129 days for pigs fed WBG and TS diets, respectively; Table II).

In this study, carcass and non-carcass components were similar (P>0.05) between treatment diets (Table III). Also, Abo-Omar (2003) re-
TABLE III
CARCASS CHARACTERISTICS OF PIGS FED LIQUID FERMENTABLE DIETS BASED ON 30% OF TOMATO SILAGE (TS) OR WET BREWER GRAINS (WBG)

<table>
<thead>
<tr>
<th>Concept</th>
<th>TS</th>
<th>WBG</th>
<th>SEM</th>
<th>P&lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to harvest</td>
<td>130</td>
<td>142</td>
<td>1.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Weight at harvest, kg</td>
<td>96</td>
<td>95</td>
<td>2.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Hot carcass weight, kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With head</td>
<td>74</td>
<td>73</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Without head</td>
<td>69</td>
<td>68</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Carnass yield, %</td>
<td>77</td>
<td>76</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Without head</td>
<td>72</td>
<td>72</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>pH post-mortem</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45min</td>
<td>6.3</td>
<td>6.4</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>24h</td>
<td>6</td>
<td>6</td>
<td>0.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Back fat thickness, mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10th rib</td>
<td>25</td>
<td>25</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>12th rib</td>
<td>22</td>
<td>22</td>
<td>2</td>
<td>0.4</td>
</tr>
<tr>
<td>Ribeye area, mm²</td>
<td>97</td>
<td>96</td>
<td>22</td>
<td>0.6</td>
</tr>
<tr>
<td>Primary cuts, kg</td>
<td>4830</td>
<td>4780</td>
<td>118</td>
<td>0.8</td>
</tr>
<tr>
<td>Heart, g</td>
<td>1580</td>
<td>1530</td>
<td>56</td>
<td>0.6</td>
</tr>
<tr>
<td>Lungs, g</td>
<td>318</td>
<td>322</td>
<td>18</td>
<td>0.7</td>
</tr>
<tr>
<td>Pluck, g</td>
<td>880</td>
<td>865</td>
<td>38</td>
<td>0.6</td>
</tr>
<tr>
<td>Empty gut, g</td>
<td>1520</td>
<td>1490</td>
<td>54</td>
<td>0.7</td>
</tr>
<tr>
<td>Small intestine, g</td>
<td>550</td>
<td>570</td>
<td>33</td>
<td>0.5</td>
</tr>
<tr>
<td>Large intestine, g</td>
<td>1280</td>
<td>1310</td>
<td>38</td>
<td>0.8</td>
</tr>
<tr>
<td>Cecum, g</td>
<td>825</td>
<td>860</td>
<td>26</td>
<td>0.6</td>
</tr>
<tr>
<td>Without head</td>
<td>162</td>
<td>172</td>
<td>22</td>
<td>0.7</td>
</tr>
</tbody>
</table>

WBG: diet served as control, SEM: standard error of the mean.

ported similar carcass and visceral organ weight when including 0, 15, 30 or 45% of by-product silage to diets of Awassi lambs. Abdullahzadeh (2012) reported similar (P>0.05) hot carcass weight and dressing percentages in goat kids fed diets containing dried tomato pomace; however, this author reported greater CP and ether extract contents in the carcasses of goat kids fed dried tomato pomace at levels of 20 and 30% compared with levels of 0 and 10%. Lira et al. (2010) added 0, 5, 10, 15 and 20% of tomato pomace to diets of broilers and reported similar (P>0.05) wings, breast and abdominal weight; however, they mentioned that the relative weights of liver and heart were greater in broilers fed tomato diets.

Conclusion

Tomato silage can be added at 30% DM basis to fermentable liquid diets of growing finishing pigs, as this diet improved growth performance without affecting carcass characteristics.

REFERENCES


