TOMATO PULP BALED SILAGE FOR FEEDING GAME

JUDIT GALLÓ[1], SZILVIA OROSZ[2], LÁSZLÓ SZEMETHY[1], ZSOLT SZABÓ[3], SZILVESZTER KAZINCZY[1],

[1]Szent István University, Faculty of Agricultural and Environmental Sciences, Institute for Wildlife Conservation, Gödöllő 2100, Páter Károly Street 1, Hungary
[2]Szent István University, Faculty of Agricultural and Environmental Sciences, Department of Nutrition, Gödöllő 2100, Páter Károly Street 1, Hungary
[3]Aranyfácán Product Co. Ltd. Hatvan, Hungary
gallojudit@gmail.com

ABSTRACT
The aim of the study was to determine the nutrient content, fermentation quality and microbial status of wet tomato pulp silage after applying different treatments in two consecutive years. In the first year, dried whole seed wheat (20% based FM) was applied in order to reduce the hazard of effluent production and undesirable fermentation processes and to increase energy content of tomato pulp. Ensiling was carried out in metal barrels/treatment with a capacity of 150-180 kg/barrel. In the second year, dried ground corn (20%) was applied for the same reasons as before and to increase nutritive value of the by-product. In the first year, the applied dried whole seed wheat (used at 20%) increased the net energy content for maintenance of tomato pulp, which has an important role in game feeding during the winter (roe deer and red deer, wild boar). The calculated lactation net energy content was similar to a maize silage harvested with approx. 25-30% starch content. Mixing of 20% dried whole seed wheat reduced significantly the acetic acid ($P \leq 0.05$), the volatile fatty acid ($P \leq 0.05$) concentration, while increased the lactic: acetic acid ratio in the core of the silages as compared to T2 (T2: 1.72±0.07 *vs* T3: 3.25±0.09). A lower fermentation intensity was found in combination with a better organic acid profile, presumably due to a higher DM content in 20% wheat treatment as compared to tomato pulp. However, it is not recommended to add whole seed to the wet by-product due to the negative effect on the top 1-20 cm layer. In the second year, low fermentation intensity was found in the control tomato pulp (20% corn) baled silage, as well as an undesirable fermentation process was found in the case of 0,5% salt treatment in the mixed tomato pulp baled silage. Therefore, application of salt is not recommended. Inoculation effectively inhibited the production of butyric acid and reduced the protein loss by 6 % as compared to the control, therefore it is highly recommended to apply as silage inoculant during the ensilage of the wet by-product. In summary, it was confirmed that the new baling system was able to form well-shaped and stable bales. High density, quick wrapping (within 120 sec after bale-forming), had a beneficial effect on fermentation quality. The study showed that wet tomato pulp had a limited fermentation capacity, but under anaerobic conditions it was possible to store for long term (100 days) with a good microbial status. It is recommended to use dried ground cereal as an additive (20%) to increase dry matter and energy content, moreover to improve volatile fatty acid composition of the wet tomato pulp silage.

Keywords: tomato pulp, bale, silage, fermentation, biological additive

INTRODUCTION

In game nutrition, using of supplementary fodder satisfied all needs of big game species (roe deer and red deer) is an important and urgent task because of reduction of costs. Supplementary fodder is important both to the females (period of pregnancy), and to the males (condition loss in the mating season). Supplementary fodder is needed in winter, when the shrub layer and juicy feeds are partly or totally missing from the forests. Tomato pulp may be a good supplementary fodder. It comes into being in the canning factories in large volumes in a short time as a by-product.

HADJIPANOYIOTOU (1994) found that ensiled tomato pulp could be a potential protein- and energy source in animal nutrition. It contains valuable seed-oil, colouring agents (lycopene, β-carotene, xhantophyll, flavons and other pigments), vitamins, aromas, i.e. their components have antibiotic and antioxidant effects.

The aim of our study was to determine the nutrient content, fermentation quality and microbial status of wet tomato pulp silage after applying different treatments in two consecutive years.

MATERIAL AND METHOD

Experiments in the first year

Ensiling was carried out in metal barrels/treatment with a capacity of 150-180 kg/barrel. Treatments were designed as follows: (T1) tomato pulp as control, (T2) tomato pulp covered with 1kg/barrel salt (NaCl) in order to reduce aerobic spoilage on the top surface, (T3) mixture of tomato pulp and dried whole seed wheat (20%) covered with 1 kg/barrel salt (NaCl), (T4) mixture of tomato pulp and dried whole seed wheat (20%) covered with 1 kg/barrel salt (NaCl) and treated with silage inoculants (*Lactobacillus acidophilus* and *Enterococcus faecium*; dose 10 kg/ton, 10^5 CFU/g fresh material).

Crude nutrients, starch, total sugar, total carotene, pH, lactic and volatile fatty acid composition, aerobic mesophyl bacteria and moulds were analysed on the 100th day of fermentation according to the Hungarian National Standards (Hungarian Feed Codex, 2004).

Experiment in the second year

Experimental treatments were as follows: (1) mixture of tomato pulp and dried ground corn (20%), (2) mixture of tomato pulp and dried ground corn (20%) treated with 0.5 % salt, (3) mixture of tomato pulp and dried ground corn (20%) treated with Sil All 4x4 silage inoculant (Enterococcus *feacium, Pediococcus acidilactici, Lactobacillus plantarum, Lactobacillus salivarius,* and amylase, hemicellulase, cellulase, pentosanase; dose: 5g/ton, 10^5 CFU/g fresh material, sprayed in 2 litre water/ton).

Baling was carried out by a Göweil LT Master fixed-chamber baler-wrapper machine. Nominal size of the bales was: 1.20 x 1.22 m. A pressure of 130 bar was applied during the baling process. Film wrap (25 µm thick) was applied 70% pre-stretched and with 6 layers (by 28 turns) and 70% pre-stretch.

Crude nutrients, starch, total carotene, pH, lactic and volatile fatty acid composition, aerobic mesophyl bacteria and moulds were analysed on the 70th day of fermentation according to the Hungarian National Standards (Hungarian Feed Codex, 2004).

In both cases, the purpose of salt addition was to increase the mineral content of the silage fed during winter time and to determine the possible antibacterial and antifungal effect of the salt in the wet by-product silage.

RESULTS

Results of the first year

Table 1. shows the chemical composition and nutritive value of different tomato pulp silages

Table 1: Nutrient content of tomato pulp silage according to the different treatments

Content		Treatment 1	Treatment 2	Treatment 3	Treatment 4
DM	g/kg	253.2	288.8	375.8	362.5
Crude protein	g/kg DM	191.1	199.2	168.7	169.1
Crude fat	g/kg DM	154.5	174.2	112.0	117.5
Crude fiber	g/kg DM	431.9	412.4	216.6	229.9
NDF	g/kg DM	574.5	541.7	332.7	336.4
ADL	g/kg DM	323	308.8	156.1	166.6
Total carotene	g/kg DM	430.2	505.7	215.3	216.1

In the case of fresh tomato pulp adequate fermentation was found (pH 4.35±0.22; total acid content 55.91±8.54g/kg DM; lactic acid: acetic acid ratio: 1.89±0.28, butyric acid: 0.64±0.17g/kg DM) with good hygienic status (4.03± 0.56 log10 CFU/g aerobic bacteria; 3.81± 0.07 CFU/g moulds) after 100 days of ensilage (Table2). Treatment T2 (salt on the top) had no significant effect on fermentation or microbial status of the tomato pulp silage either on the top, or in the core. There is a presumable explanation, that the packed tomato pulp density was so high (208.7 kg DM/ m^3), that the aerobic spoilage on the surface (3-5 cm on the top) had no effect on the fermentation in the core (50 cm depth). However, the salt was ineffective even on the top, observing a similar spoiled layer in both treatments T1 and T2 (3-5 cm). Mixing of 20% dried whole seed wheat reduced significantly the acetic acid ($P \leq 0.05$), the volatile fatty acid ($P \leq 0.05$) concentration, while increased the lactic:acetic acid ratio in the core of the silages as compared to T2 (T2: 1.72±0.07 *vs* T3: 3.25±0.09). According to the results, in treatment T3 a lower fermentation intensity was found in combination with a better organic acid profile, presumably due to a higher DM content in treatment T3 (375.8 g/kg DM), than in T2 (288.8 g/kg DM). However, aerobic spoilage was found in the top 20 cm of the mixed silages compared to T2, where the spoiled layer was just 3-5 cm. Therefore it is not recommended to add whole seed to the wet by-product due to the negative effect on the top 1-20 layer (aeration). It is suggested using dried ground cereal as fine structural and hygroscopic additive. The applied microbial additive had negative effect on fermentation in the case of mixed tomato pulp silage (significantly higher acetic acid ration and mould $P \leq 0.05$, and higher propionic acid-, volatile fatty acid- with lower LA:AA ration as compared to T3 treatment,)

Dried whole seed wheat (used at 20%) increased the net energy content for maintenance of tomato pulp (NEm: 4.88 MJ/kgDM; NEg: 2.53MJ/kgDM; NEl: 4.46MJ/kgDM) by 38.7% (NEm: 6.77MJ/kgDM; NEg: 4.20MJ/kgDM; NEl: 6.18MJ/kgDM), which has an important role in game feeding during the winter (roe deer and red deer, wild boar). The calculated lactation net energy content is similar to a maize silage harvested with approx. 25-30% starch content.

Table 2: Fermentation profile of the different tomato pulp silages (n=5)

Treatments			Treatment T1	Treatment T2	Treatment T3	Treatment T4
pH		Mean	4.35	4.30	4.20	4.29
		Std. dev.	0.22	0.11	0.04	0.03
Lactic acid	g/kg DM	Mean	35.96	33.20	31.16	33.40
		Std. dev.	7.17	3.00	3.28	3.64
Acetic acid	g/kg DM	Mean	18.95a	19.28a	9.61b	12.46c
		Std. dev.	2.15	1.19	1.13	0.38
Propionic acid	g/kg DM	Mean	0.35	0.18	0.06	0.18
		Std. dev.	0.33	0.06	0.04	0.06
Butyric acid	g/kg DM	Mean	0.64	1.59	0.22	0.23
		Std. dev.	0.17	1.10	0.11	0.16
Volatile fatty acids	g/kg DM	Mean	19.95a	21.05a	9.89b	12.87b
		Std. dev.	1.94	1.23	1.15	0.38
Organic acids	g/kg DM	Mean	55.91a	54.26a	41.05b	46.28a
		Std. dev.	8.54	4.04	4.40	3.61
LA/AA ratio	g/g	Mean	1.89a	1.72a	3.25b	2.68b
		Std. dev.	0.28	0.07	0.09	0.31
AEMB	log10 CFU/g FM	Mean	4.03	4.00	3.47	3.98
		Std. dev.	0.56	0.44	0.15	0.69
Moulds	log10 CFU/g FM	Mean	3.81a	3.76a	4.07a	4.63b
		Std. dev.	0.07	0.23	0.28	0.23
Total sugar	g/kg DM	Mean	4,95a	4,95a	10,30b	12,52b
		Std. dev.	1,32	1,61	3,26	1,88

Different letters show significant differences at level of $P \leq 0.05$

Results of the second year

Table 3. shows the chemical composition and nutritive value of the fresh tomato pulp and different tomato pulp silages

Table 3: Nutrient content of fresh tomato pulp, dried ground corn and baled tomato pulp silages according to the different treatments

	Fresh tomato pulp	Treatment 1	Treatment 2	Treatment 3
DM (g/kg)	269.3	408.3	409.2	375.5
Crude protein (g/kg DM)	197.9	146.1	147.3	147.4
Crude fiber (g/kg DM)	400.9	209.2	216.0	217.4
Total starch (g/kg DM)	24.0	283.1	313.9	290.2
Total carotene (mg/kg DM)	167.8	144.1	147.2	146.0
Aerobic bacteria (ln CFU/g)	5.00			
Moulds and yeasts (ln CFU/g)	1.90			

Fresh tomato pulp (DM 269.3 g/kg; 197.9 g/kg DM crude protein; 400.9 g/kg DM crude fiber;*(Table 3.)* 5.00 log10 CFU/g aerobic bacteria; 1.90 log10 CFU/g moulds and yeasts) were mixed with 20% hygroscopic dried ground corn in order to reduce the risks of effluent production and an un-desirable fermentation processes, moreover to increase nutritive value of the by-product (baled tomato pulp silage ensiled with 20% dried ground corn: 6.84 MJ/kg DM NE_m; 6.33 MJ/kg DM NE_l and 4.26 MJ/kg DM NE_g). Dried ground corn (used in 20%) increased the net energy content for maintenance of tomato pulp by 40% (tomato pulp 4.88 MJ/kg DM NE_m; 2.53MJ/kgDM NE_g; 4.46MJ/kgDM NE_l), which has an important role in game feeding in the winter time (roe deer and red deer, wild boar).

The calculated lactation net energy content is similar to maize silage harvested with approx. 30-35% starch content.

It was confirmed that the new baling system was able to form well-shaped and stable bales such a wet by-product as fresh tomato pulp with a small particle size (initial dry matter range of the mix was 362.6-375.7 g/kg). Extreme bale weight (1120±12.6 kg/bale, n=6), high density (355±4.0 DM kg/m^3, n=6) and low density-deviation were achieved with the new technology due to high pressurization (130 bar) and small particle size. Effluent amount range was 6-10 litres per bale. High density, quick wrapping (within 120 sec after bale-forming), has a beneficial effect on fermentation quality. However, low fermentation intensity was found in the case of control tomato pulp (20% corn) baled silage (total acid content 42.1±1.9 g/kg DM; pH 5.0±0.2; butyric acid: 1.5±0.8 g/kg DM). An undesirable fermentation process was found in the case of 0.5% salt treatment in the mixed tomato pulp baled silage (total acid content 55.5±15.2 g/kg DM; pH 5.1±0.1 P=0.034; LA:AA: 1.7±0.2; butyric acid: 1.5±0.8 g/kg DM P=0.042,), therefore application of salt is not recommended. Inoculation effectively inhibited the production of butyric acid (total acid content 42.3±2.1 g/kg DM; pH 4.6±0.0; butyric acid: 0.0 g/kg DM) -see Table 4-, and reduced the protein loss by 6 % as compared to the control, therefore it is highly recommended to apply as silage inoculant during the ensilage of the wet by-product

Table 4: Fermentation profile of the different baled tomato pulp silages (n=3)

			Treatment T1	Treatment T2	Treatment T3
pH		Mean	4.97a	5.13b	4.57a
		Std. dev.	0.16	0.14	0.05
Lactic acid	g/kg DM	Mean	17.85	16.32	19.82
		Std. dev.	5.11	1.87	3.88
Acetic acid	g/kg DM	Mean	9.16	9.63	10.39
		Std. dev.	1.21	0.10	0.90
Propionic acid	g/kg DM	Mean	1.46	6.24	0.85
		Std. dev.	0.25	8.14	0.00
Butyric acid	g/kg DM	Mean	1.48a	3.70b	0.00a
		Std. dev.	0.80	0.77	0.00
Volatile fatty acids	g/kg DM	Mean	12.10	19.57	11.24
		Std. dev.	1.95	8.01	0.90
Organic acids	g/kg DM	Mean	42.05	55.45	42.29
		Std. dev.	1.93	15.19	2.07
LA/AA ratio	g/g	Mean	2.02	1.70	1.93
		Std. dev.	0.80	0.20	0.54

Different letters show significant differences at level of P≤0.05

CONCLUSIONS

Conclusions of the results of the first year

The study showed that wet tomato pulp had a limited fermentation capacity, but under anaerobic conditions it was possible to store for long term (100 days) with a good microbial status. It is recommended to use dried ground cereal as an additive (20%) to increase dry matter and energy content, moreover to improve volatile fatty acid composition of the wet tomato pulp silage.

Conclusions o the results of the second year

Based on the experimental results, it can be concluded, that the new bale-forming technology provides stable wet tomato pulp silage (20% ground corn) for long term storage, moreover, the transportable baled silage with considerable energy and protein concentration and as carotene source can have beneficial effects in game feeding during the winter time. Application of a biological additive is recommended in order to inhibit undesirable fermentation processes in the baled tomato pulp silage.

ACKNOWLEDGEMENTS

It is a pleasure to thank those who made this experiment possible. We offer our regards and blessings to all of those who supported us in any respect during the completion of the project. Special thanks to Aranyfácán Product Kft, who made our experiment possible.

REFERENCES

HADJIPANAYIOTOU (1994): Laboratory evaluation of ensiled olive cake, tomato pulp and poultry litter. Livestock Research for Rural Development. Volume 6, Number 2, October 1994 Agricultural Research Institute, Nicosia, Cyprus.
http://www.cipav.org.co/lrrd/lrrd6/2/cyprus1.htm