Crude olive cake as additive for corn and grass silage: fermentative loss

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Introduction The olive crop in Brazil has experienced a huge development in the last years. The Rio Grande do Sul state is the largest producer, being responsible to 50% of the national production on 3,464 ha (IBGE, 2017; Secretaria da Agricultura do RS, 2019). A considerable part of the olive production is processed to extraction of olive oil. However, processing olive results in the production of crude olive cake (OC), a by-product that cannot be discarded in the environment because its polluter potential. The OC is rich in energy (~10% of ether extract) and because that, it also deteriorates quickly in the presence of oxygen (Hadjipanayiotou, 1999). Actually this by-product represents a problem for the olive industry, and therefore, finding a fate for OC is needed. The OC was previously assessed for animal feeding as *in natura* or ensiled, but no investigations have been conducted regarding its potential to be used as silage additive. Thus, our objective was to investigate the impact of OC as additive on fermentative loss of corn and grass silage.

Material and methods A corn hybrid (AS 1596, Agroeste, Cascavel, PR, Brazil) and Elephant grass cv. BRS Kurumi were grown in two commercial farms located at Pelotas - RS. According to the Köppen Geiger's classification, the regional climate is classified as 'Cfa', being humid subtropical with hot summers. On 3 April 2019, whole-crop corn and Elephant grass were randomly harvested in different locations in the field at a respective stubble height of 20 and 15 cm using a sickle. Whole-crop corn was harvested at 1/2 of kernel milk line (32.6% dry matter (DM)) and Elephant grass was wilted (22.9% DM) for 4 h prior chopping. Thereafter, the forages were cut to a theoretical length of 20–30 mm using a stationary chopper. Six piles of corn forage were individually treated with fresh OC (5% as fresh basis), and other six piles remained without OC (untreated). The same procedure was performed to the Elephant grass. The application of OC onto the forages was made under constant manual mixing. The OC (32.5% DM and 11.9% of ether extract) was obtained from an olive industry (Estancia Guarda Velha, Azeite Batalha, Pinheiro Machado, RS, Brazil) and stored at 4°C prior to application. Ensiling was performed using two mini-silos (PVC tubes with capacity for 2.5 L) per each statistical replicate (n = 3) to have sufficient silage for latter measurement of chemical analyses and aerobic stability assay. Dry sand (350 g) was placed on the bottom of each mini-silo to quantify effluent production. Sand was kept apart from the silage using a plastic screen. Mini-silos remained stored at room temperature (18.3 ± 1.22°C) for 99 d. Mini-silos were weighed before and after ensiling to determine DM loss (Jobim et al., 2007); the forages were also analyzed for DM concentration. After the silos were opened, the silage temperature was immediately recorded by dataloggers. Data (n = 3) were analyzed as a completely randomized design under a 2 (two forages) × 2 (with or without OC) factorial arrangement using the MIXED procedure of SAS (v. 9.4). Differences between means were determined using the PDIFF option of LSMEANS at $P \leq 0.05$.

Results and discussion Although not directly studied to date as additive, OC may have the potential to alter the fermentation of forage crops via their effects on microorganisms associated with this process. This hypothesis is supported by the fact that changes in rumen bacterial community of an experimental diet treated with stoned olive pomace were previously reported under *in vitro* conditions (Pallara et al., 2014). However, fermentative loss were unaffected by OC ($P \geq 0.17$; Table 1) in the current study, suggesting that OC has little effect on microbial population of silage or the level used at ensiling was quite low to detect any effect. In opposite, the temperature of corn and grass silages slightly increased ($P = 0.009$; +0.7 and +0.6°C as compared to the untreated one, respectively) following OC treatment, but this result might be of minor biological importance. Conversely, crops were found to significantly affect effluent ($P = 0.014$), gas loss ($P = 0.036$), and DM loss ($P = 0.047$). Surprisingly, the effluent production was higher in corn silage than in grass silage. It is known that effluent production is inversely associated with DM concentration, but wilting may considerably reduce effluent losses in the ensiled crops (Muck, 1988). Gas and DM losses were lower in corn silage, which might be associated with the better features of this crop for ensiling as compared to grass.

Table 1 Dry matter (DM) loss and temperature of corn and grass silage treated with 5% of crude olive cake (as fresh basis).

Item	Corn silage		Grass silage		SEM	*P*-value[3]		
	U[1]	5% OC	U	5% OC		C	OC	C × OC
Eflluent, kg/t[2]	7.45	8.23	1.53	3.17	1.75	0.014	0.51	0.81
Gas loss, % DM	6.06	6.24	7.54	10.4	1.12	0.036	0.22	0.28
DM loss, %	6.17	6.59	7.56	10.6	1.15	0.047	0.17	0.28
Temperature, °C	13.5	14.2	13.8	14.4	0.196	0.27	0.009	0.74

[1]U = untreated; [2]Fresh forage basis; [3]C = crop, OC = crude olive cake, C × OC = interaction between crop and olive cake.

Conclusion Partial results of this study indicated that OC has no effect on fermentative loss when used at 5% (as fresh basis). Thus, applying OC at ensiling of corn and grass can be a viable fate for its use from the olive industry.

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