QUALITY AND NUTRITIVE VALUE OF ALFALFA AND GRASS SILAGES WITH BIOLOGICAL ADDITIVES

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ABSTRACT
The present study satisfactorily utilized some food industry by-products for improving fermentation characteristics, quality and nutritive value of silages. Five kinds of preparations were made: sugar-enzymes based (beet molasses and brewer's yeast, mycelium of *Aspergillus niger*, malted barley at 3:3:3:1); enzymes-bacteria based (mycelium of *Aspergillus niger*, malted barley, acidic whey, fermentation broth and lactic acid bacteria or skim milk powder at 3:0.9:3:0.1); sugar based (molasses and brewer's yeast at 1:1) and concentrate of lactic acid bacteria only. Untreated or additive-treated first-cut low sugar (60g kg^{-1}DM, 19.4% DM) alfalfa (*Medicago sativa*) plus grasses (*Phleum pratense* and *Dactylis glomerata*) was ensiled. The percentage of forage in the mixture was 80:15:5, respectively. Data are given on chemical composition, energy content, PDI value, fermentation characteristics and quality of silages.

KEYWORDS
Alfalfa / grass, silage, stimulants, quality, nutritive value

INTRODUCTION
Fermentation characteristics and silage quality can be improved by an application of biological and chemical additives. An increasing number of studies (Gordon, 1989; Harrison *et al*., 1989; Mir *et al*., 1994; Sajko *et al*., 1994, 1995; Selmer-Olsen *et al*., 1993) have reported positive benefits of biological conservation agents (eg. lactic acid bacteria or fibre degrading enzymes) on proper orientation of fermentation processes, improvement of the silage quality and reduction of nutrients losses during ensilage.

The objective of this study was to recognize the ways of utilizing some food-industry by-products (sources of sugars, enzymes and bacteria) for stimulation of fermentation process during ensilage of alfalfa plus grasses.

The evaluation of used biological additives has been done in terms of silage composition, nutritive value and chemical indices of silage fermentation quality.

Abbreviations: ADF, acid detergent fibre; **CP,** crude protein; **DM,** dry matter; **NDF,** neutral detergent fiber; **OM,** organic matter; **PDI,** protein digested in the small intestine;**PDIA,** rumen-undegraded dietary protein; **PDIN, PDIE,** PDIA plus PDI supplied by microbial protein from rumen-degraded protein and microbial protein from rumen-fermented OM, respectively; **UFL, UFV,** feed unit for milk and meat , respectively; **WSC,** water soluble carbohydrates.

MATERIALS AND METHODS
First-cut of mixture containing 80% alfalfa (*Medicago sativa*), 15% timothy (*Phleum pratense*) and 5% cocksfoot (*Dactylis glomerata*) was ensiled unwilted (194g DM; 170g CP and 60g WSC kg^{-1}DM) in the amount 200 kg/1storage container. The following kinds of biological stimulants were used:
- beet molasses (source of saccharose and inverted sugars) and brewer's yeast in ratio 1:1. Yeast mixed with molasses to disintegrate yeast cells.
- mycelium of *Aspergillus niger* (by-product from citric acid production); source of pectinolitic and cellulytic enzymes. It was preserved in vacuum drier at 40^0C.
- malted barley-source of amylo-, proteo-, cellulytic enzymes.
- fermentation broth-the residue of lactic acid bacteria(10^4-10^5/cm^3) and calcium lactates. Fermentation broth was condensed at 50^0C by 16.3 % of DM content.
- acidic whey (lactic acid and mesophilic lactic acid bacteria); 40% DM; 7.8% CP; 70% sugars.
- concentrate of lactic acid bacteria (count of bacteria - 10^{10}/1 g).

Two types of preparations were composed (Table 1): one having both a direct sugar-enriching character (molasses) and an indirect sugar enriching character through the presence of an enzymatic system in the mycelium of *Aspergillus niger* and malted barley (Preparation No. 2); and preparation No. 3A, having a preserving character (lactic acid bacteria, acidic whey, fermentation broth). Since the above-mentioned preparations consisted of products which can be ensiling process stimulants by themselves irrespective of the composition, additional versions 1, 3B, 4 - control ones for preparations 2 and 3A and corresponding to the concentrations of products in the preparations under study - were introduced.On day 70 after ensiling, samples of silages were analysed for chemical composition, pH, •-carotene and organic acids. Procedures to determine the above analyses were described by Sajko et al. (1994, 1995). Estimation of NDF and ADF was carried out according to Van Soest and Wine (1967). Nutritive value was calculated on the basis of the French system (INRA, 1988).

RESULTS AND DISCUSSION
Utilization of food industry by-products to improve fermentation processes at ensiling brought about an increase mainly in WSC, reduced ß-carotene loss (179 mg vs 195-252 mg kg^{-1}DM) and increased the energy value of silages (0.76 UFL and 0.66 UFL in untreated vs 0.81-0.83 UFL and 0.72-0.74 in supplemented). Enriching alfalfa plus grass with high sugar-content additives (e.g. acidic whey, fermentation broth, molasses) determined the increase of the PDI value, first of all PDIE, dependent on the concentration of available energy. The use of preparation with the content of mycelium of *Aspergillus niger* and malted barley-source of cellulytic and pectinolytic enzymes, caused an increased degradation of plant cell wall constituents that were more susceptible to bacterial decomposition, which corresponds to other authors' findings. Selmer-Olsen et al. (1993) observed a 10-15% disappearance of cellulose and hemicellulose from herbages treated with the fungal enzyme preparation. The course of fermentation in all experimental versions of ensiling was more extensive, as indicated by a greater decline of pH (4.0-4.4 vs 5.4) caused by an increased amount of organic acids. Irrespective of the variant, there was a considerable improvement of the supplemented silages quality (62 - 98 points vs only 6 points). An increased rate and extent of lactic acid production and pH decline in inoculant treated low sugar (69g WSC kg^{-1}DM) alfalfa plus grass is in good agreement with Sajko et al. (1995). However, the response of adding supplementory sugars-substrat and inoculant was greater (96 vs 62 points in silage No. 3A and No.4, respectively). Similarly, a utilization of both molasses and yeast together with the source of enzymes in the form of mycelium of *Aspergillus niger* and malted barley (Preparation No. 2) improved the qualitative parameters of the silage (98 vs 77 points) compared with an exclusive use of molasses and yeast (Preparation No.1) in the amount analogous with that of silage No.2. The results obtained indicate a possibility of

utilizing some food industry by-products in order to stimulate lactic fermentation in the process of ensiling and improve the nutritive value of silage.

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Table 1

Composition of preparations (%)

	Preparation No:					DM	CP	Sugars
	1	**2**	**3A**	**3B**	**4**	%	g kg^{-1}DM	g kg^{-1}DM
Beet molasses and brewer's yeast 1:1	100	60	-	-	-	60.4	175	692
Mycelium of *Aspergillus* niger	-	30	30	30	-	85.2	571	53
Malted barley	-	10	9	9	-	94.8	455	201
Acidic whey	-	-	30	30	-	40.0	78	739
Fermentation broth	-	-	30	30	-	16.3	60	607
Skim milk powder	-	-	-	1	-	93.0	350	561
Concentrate of lactic acid bacteria	-	-	1	-	100	87.7	532	178
Total (%)	100	100	100	100	100			

Table 2

Nutritive value and quality of silages

Silage No :	Control	**1**		**2**	**3A**	**3B**	**4**
Application rate %):	0.0	2.0	1.2	2.0	2.0	2.0	0.2
DM (g kg^{-1})	194	224	214	209	211	210	204
Composition of DM:							
CP	162	148	152	162	151	153	154
OM	948	947	951	951	951	949	946
NDF	331	309	285	292	341	281	329
ADF	281	241	233	256	278	251	284
Hemicellulose	50.5	68.9	51.8	36.4	63.5	30.0	44.9
WSC	8.6	9.3	5.8	8.1	10.5	11.9	7.6
Beta-carotene (mg)	179	195	245	245	252	252	245
Nutritive value (kg^{-1}DM):							
UFL	0.76	0.82	0.83	0.82	0.83	0.82	0.81
UFV	0.66	0.73	0.74	0.73	0.74	0.73	0.72
PDIA	22	32	30	32	30	30	31
PDIN	92	94	89	94	88	89	90
PDIE	49	71	66	71	70	69	67
Acid content (g kg^{-1}DM):							
Lactic	53.6	166.8	156.7	187.0	145.0	176.2	93.3
Acetic	84.5	56.3	80.7	40.7	41.7	52.4	100.2
Butyric	31.9	-	-	-	-	-	-
pH	5.36	4.03	4.27	4.09	4.39	4.20	4.10
Evaluation according to Flieg-Zimmer scale (points) :	6 bad	93 very good	77 good	98 very good	96 very good	96 very good	62 good