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## Technology of Corn Steep Application in Animal Mashs and their Quality

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### Abstract

*Chemical characteristics of corn steep obtained from naturally dried corn, of condensed corn steep and of mashs with and without corn steep additions were determined. The results obtained point to the value of corn steep as a feed ingredient rich in proteins and mineral matters. Condensed corn steep can be successfully used in feed industry improving the amino acid composition of feed mashs and enchanting the pelleting process.*

**Keywords:** corn, corn steep, evaporation, feed mash, chemical characteristics, animal feed

### Introduction

In the technological process of wet milling, besides raw starch, one obtain also corn germ, bran, gluten and corn steep. Corn steep comprises 6-8% of corn dry matter. In Yugoslavia in limited quantities it is used in the brewing industry. The rest, almost all, is released into the sewerage and pollute the environment though it is contains corn solubles and degradable and fermented products originated during the steeping process. According to the references, waist water from the starch factory contains around 7.0 kg of the biological need for oxygen per ton of processed corn (1). Many authors investigated the possibility of corn steep application as a raw material for biological protein synthesis. In fact, this process is the process for purifying waist starch industry water and in the same way valuable ingredients from corn steep are promoted to a better-valorized product. Due to many vitamins, amino acids, nitrogen compounds and mineral matters, corn steep is a very suitable nutritious substratum that was already emphasized by many authors (2, 3, 4, 5, 6, 7).

The possibility of corn steep application as a nutritious substratum in industrial fermentation for animal yeast processing was pointed by Behr (3), but Conrady (2) thoroughly investigated the application of corn steep in the production of the following yeasts: *Torula utilis*, *Saccharomyces cerevisiae* and *Candida pseudotropicalis*.

Based on numerous references concerning corn steep application in the animal feed industry, it is pointed that this nutrient should be included into feed mashs also in Yugoslavia. Ruso et al. (8) detected stimulating influence of concentrated corn steep as a replacement for soya meal in feed mashs for chicken, but Carvani et al. (9) proved that corn steep is a good replacement for soya meal in feed for lambs. Several authors proved increased animal weight gain in animals fed with mashs containing concentrated corn steep in comparison to the animals: pigs (10), chickens (11, 12 13) and ruminants (10, 13, 14) fed with food without this food component. The presence of dry corn steep in feed mashs for laying

hens and turkeys (15) increased the number of eggs. Besides this, the presence of dry corn steep in feed mashes for laying hens improved egg quality (16).

The aim of these investigations is to determine chemical characteristics of corn steep in order to evaluate the importance and quality of corn steep as a component of feed and to broaden and rationalize the application of this product in animal feed industry.

## Material and Methods

Corn steep and condensed corn steep originated from the Starch factory in Jabuka and were sampled in the naturally dried corn processing. Corn steep was concentrated in evaporating station and added to the Feed mash in the feed factory in Jabuka, too.

Basic chemical composition was determined according to "Official Methods of Analysis" (17).

Fractions of nitrogenous material were determined according to the methods listed in the biochemistry handbook (18).

Amino acids were determined on automatic amino acid analyzer by chromatographic separation on ionexchange resin (19).

Potassium and sodium were determined by flame photometry, calcium by complexometry, and phosphorus and iron by spectrophotometry (17).

Starch was determined by polarimetric analysis (20) and sugars were determined before and after the hydrolysis of alcoholic extract and expressed as a content of reducing total sugars (21).

Total acidity was determined by titration and content of SO<sub>2</sub> by iodine method (22).

pH was measured by electrochemical method according to Yugoslav standard (23).

## Results and Discussions

Basic chemical composition of corn steep in the naturally dried corn processing is in accordance with literature cited by El Marsafy et al (24), Conrady (2), Watson (25) and Filipović et al. (26, 27, 28). All authors gave different influences for solids in corn extract. Abdel-Akher et al. (29) cited that substantial amounts (round 43%) of corn grain proteins comprised protein component of corn steep, but Watson (30) stated that proteins of microbiological origin due to milk fermentation could make up a considerable amount of proteins in this product. Mineral matters originated exclusively from the corn that was processed. Therefore, mineral matters in steep vary only due the content of these minerals in the corn as a raw material. From the total nitrogen content of corn steep, the greatest share comprises non-protein fractions, followed by alfa amino nitrogen, non-protein and some ammonium nitrogen (0.61%). These results are in accordance with the data reported by Marsafy et al (24) and others. Condensed corn steep contains much more dry matter, but the basic chemical composition has not been considerably changed in comparison to the non condensed one, but protein and mineral decreased. During evaporation total and reducing sugars also decreased and pH changed, i.e. concentration of SO<sub>2</sub> changed.

From the nutritive point of view amino acid pattern in feed mashes is very important. In corn steep and in condensed corn steep, the most frequent are the following amino acids: glutamic acid, proline, alanine, leucine, asparagine acid and valine. These data are in accordance with data cited by Salem (31), Riners (32), Conrad (2) and others. In these products, it is very important to emphasize the content of methionine and lysine because of their importance in animal feeding.

Condensed corn steep was added to feed mash in the quantity of 1,30% in the pelleting process. In the literature there are data that condensed corn steep is used as a binding

component and improved the quality of pellets. Based on data presented in the table 3, it can be seen that addition of condensed corn steep increased protein content in feed mash for 6,82% and also improved amino acid composition. Amino acids increased for 2,7% and particularly increased metionine – 5,32% and cystine – 15,4%.

The possibility of the addition condensed corn steep for pelleting feed was also investigated within the scope of this experiment. Based on data considering pelleting process, it can be recommended that industry of animal feed can use condensed corn steep at environmental temperature without any technical difficulties in feed pelleting.

**Table 1.** Chemical characteristics of corn steep and condensed corn steep from naturally dried corn

(%) in dry matter	Corn steep	Condensed corn steep
Dry matter	5.27	49.74
Crude protein	50.84	45.64
Protein nitrogen	1.511	1.28
Non protein nitrogen	6.62	6.02
Alfa amino nitrogen	2.60	1.72
Ammonium nitogrnr	6.61	0.60
Crude fat	-	-
Crude fiber	-	-
Mineral matters	18.24	17.05
Calcium	0.21	0.19
Phosphorus	3.02	2.15
Iron	0.03	0.03
Potassium	3.80	3.17
Sodium	0.14	0.10
Total sugars	5.65	3.31
Reducing sugars	3.50	2.54
Starch	-	-
SO <sub>2</sub>	0.83	0.47
PH	3.94	4.25
Acidity as lactic acid	40.12	28.03
Acidity as HCl	16.26	11.36

**Table 2.** Amino acid content in corn steep and condensed corn steep from naturally dried corn

(%) in dry matter	Corn steep	Condensed corn steep
Asparagine acid	3.04	2.34
Threonine	2.02	1.85
Serine	2.39	2.02
Glutamic acid	6.49	5.34
Proline	5.20	4.89
Glycine	2.64	2.28
Alanine	4.12	3.87
Cystine	0.57	0.47
Valine	2.54	2.20
Metionine	0.89	0.74
Isoleucine	1.64	1.31
Leucine	4.44	3.79
Tyrosine	1.37	1.17
Phenylalanine	1.66	1.40
Histidine	1.77	1.36
Lysine	1.44	1.20
Arginine	2.28	1.86

**Table 3.** Chemical characteristics and amino acid content of pelleted feed mash for pigeons with and without the addition of condensed corn steep (%d.m.)

Item	Without condensed corn steep	With condensed corn steep
Crude protein	17.92	19.23
Crude fiber	4.97	5.20
Crude fat	4.54	4.33
Mineral matters	8.41	8.80
<b>Amino acids:</b>		
Asparagine acid	1.56	1.61
Threonine	0.68	0.70
Serine	0.86	0.88
Glutamic acid	2.95	3.03
Proline	1.20	1.32
Glycine	0.74	0.76
Alanine	1.11	1.15
Cystine	0.22	0.26
Valine	0.78	0.79
Metionine	0.36	0.38
Isoleucine	0.77	0.78
Leucine	1.56	1.58
Tyrosine	0.78	0.81
Phenylalanine	0.96	0.94
Histidine	0.78	0.78
Lysine	0.85	0.86
Arginine	1.07	1.07

## Conclusion

On the basis of corn steep chemical characteristics and possibilities for the application of condensed corn steep in feed industry we may conclude the following:

Corn steep from naturally dried corn is a valuable protein nutrient that has a small content of dry matter (5.27%).

Condensed corn steep having 49.74% of dry matter in which proteins are prevalent (45.64%) and the share of minerals is significant, make this product a valuable feed nutrient.

In existing feed industry, condensed corn steep can be successfully used for producing pelleted feed.

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