Silage

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Introduction

- Silage is a type of animal fodder which is used by dairy farmers across the globe.
- Silage is fed to different types of cattle such as sheep, goat, cows, and buffaloes.
- In a country that has the largest cattle inventory in the world, **silage making** is a vital part of the dairy farming process.

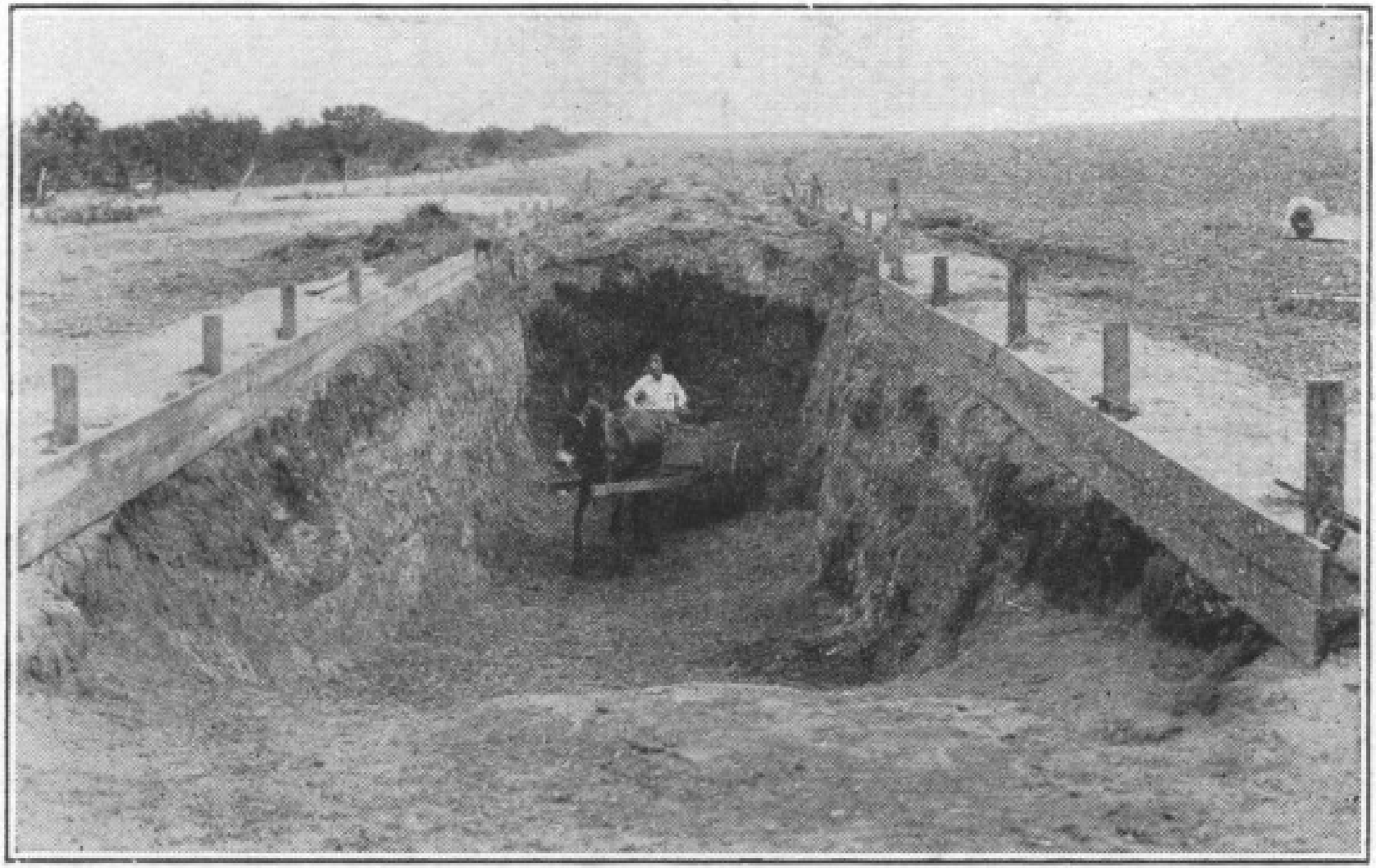
Crops suitable for silage making in India

- In the Indian context, according to the National Dairy Development Board (NDDB), fodder crops that are suitable for silage making are:
- Maize (मक्का)
- Sorghum (जंवार)
- Pearl Miller (बाजरा)
- Hybrid Napier (संकर नेपियर घास)

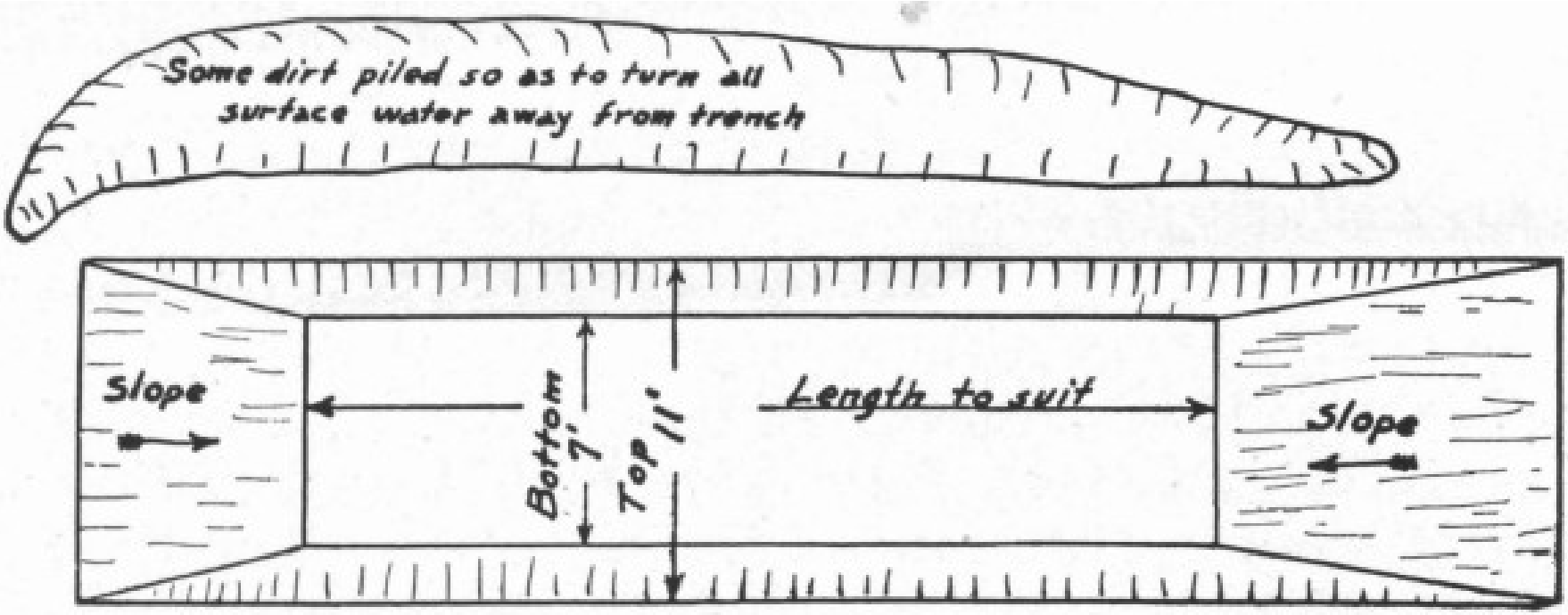
Requirements for silage making

- A quality crop in the first place ideal for making silage.
- You would need appropriate farm machinery such as tractors, silage baling machines etc.. for mass production.
- You would need a silo or a trench for storing the silage that has been prepared.
- It is also important to understand, the quality of silage preparation can be improved significantly with the help of additives such as molasses, urea, salt and formic acid.
- It is estimated by NDDB, that production of 100MT of green fodder would cost about 12 lakh INR in machinery investment.

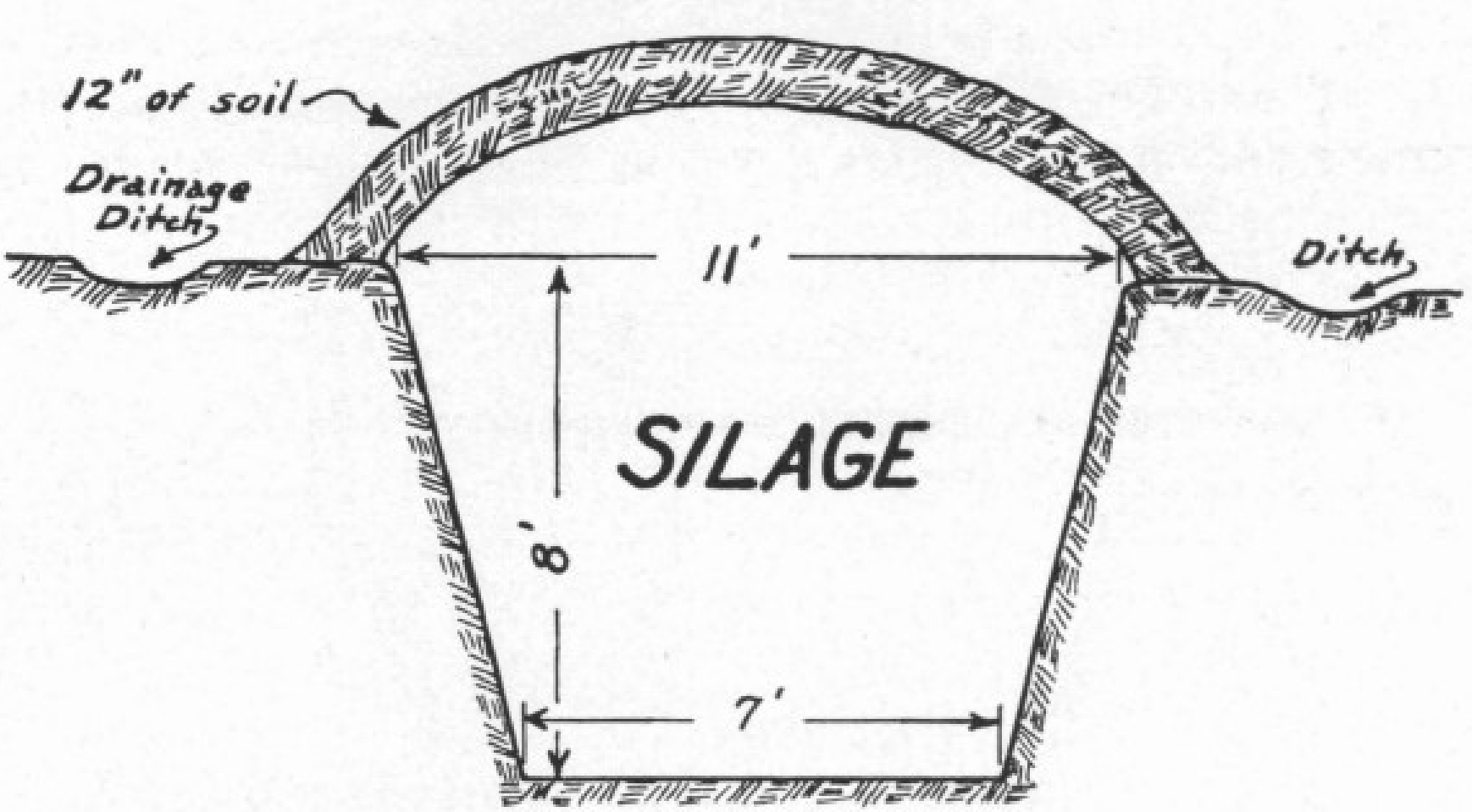
Picture: Silos for storing silage



Picture: Trench Silo for storing silage



Plan of trench silo.



Cross section of trench silo after silage covering has been put on.

Different types of silages

In general, the common classification under which the silages are separated are:

- High-moisture silage (less than 30% dry matter)
- Medium-moisture silage (30 – 40% dry matter)
- Low-moisture silage (< 30% dry matter)

Silage Making Process:

- The pasture is cut when the grasses contain the highest nutrient levels. This level is attained just before they are fully mature.
- The grass is allowed to wilt in the field for a few hours to reduce the moisture content to around 60-75% as this is the optimum level. If the grass is left out longer, it may get too dry, or it may get rained on – and both these will reduce the efficiency of the fermentation.

Fermentation Process:

- During the fermentation process, the cut grass is chopped into even smaller pieces (0.5 inches or 1.3 cms) and then compressed to eject the oxygen more efficiently. This is important because the microorganisms especially, lactic acid bacteria, grow best under anaerobic (oxygen-free) conditions.
- When oxygen remains, plant enzymes and other bacteria react with the plant sugars and proteins to make energy, thus reducing the amount of nutrients in the final product.

Storage of Silage

- After the first two steps, the next step is to seal the compressed grass with plastic to keep oxygen out. Mounds of **silage** are covered with huge polythene (plastic) sheets and weighted down (usually with old tires) to ensure maximum compression.
- Bales, on the other hand, are just covered with plastic wrapping.
- In cases where the **silage** is to be stored in a large pit, tractors and other machinery are usually driven over the grass pile until it is firm. If the **silage** is stored as bales, baling machines will be used to compress the grass.

Preserving Technique

- After the fermentation process is done and once all of the oxygen is used up, lactic acid bacteria start to multiply. These are the bacteria that are needed to make the **silage**.
- They play a key role in turning the plant sugars into lactic acid causing the pH to drop (mixture becomes more acidic). Once the pH is around 4-5, the sugars stop breaking down and the grass is preserved until the silage is opened and exposed to oxygen.
- If the pH isn't low enough, a different kind of bacteria will start fermenting the silage, producing by-products (like ammonia) that taste bad to cows and sheep. Thus, the latter situation needs to be avoided at all costs.

Chemistry and Microbiology of Silage

TABLE 1: General description of crops and silages
(A. G. KEMPTON4 AND C. L. SAN CLEMENTE, 1959)

Quality Group	Silo No.	Crop	Quality of Crop	Final pH	Composition at End of Storage Period: Fresh Matter (μmoles/g.)		
					Lactic acid	Butyric acid	Volatile base
Well preserved	1	June clover	Excellent	4.4	180	0	25
	2	Alfalfa, brome	Excellent	4.1	245	0	35
	3	Oats	Excellent	4.4	149	0	43
	4	Alfalfa, alsike	Excellent	5.2	113	0	42
	5	Alfalfa	Good	4.4	138	0	57
	6	Mammoth clover	Excellent	4.3	156	0	30
Spoiled	7	Alfalfa	Excellent	5.9	3	99	137
	8	Alfalfa	Excellent	5.8	2	89	104
	9	Alfalfa, brome	Excellent	5.4	0	108	110
	10	Alfalfa	Excellent	5.1	3	42	42
	11	Alfalfa, alsike	Good	5.8	1	128	177
Overheated	12	Alfalfa	Poor, weedy	4.4	40	1	57
	13	Alfalfa	Fair	5.0	29	0	35

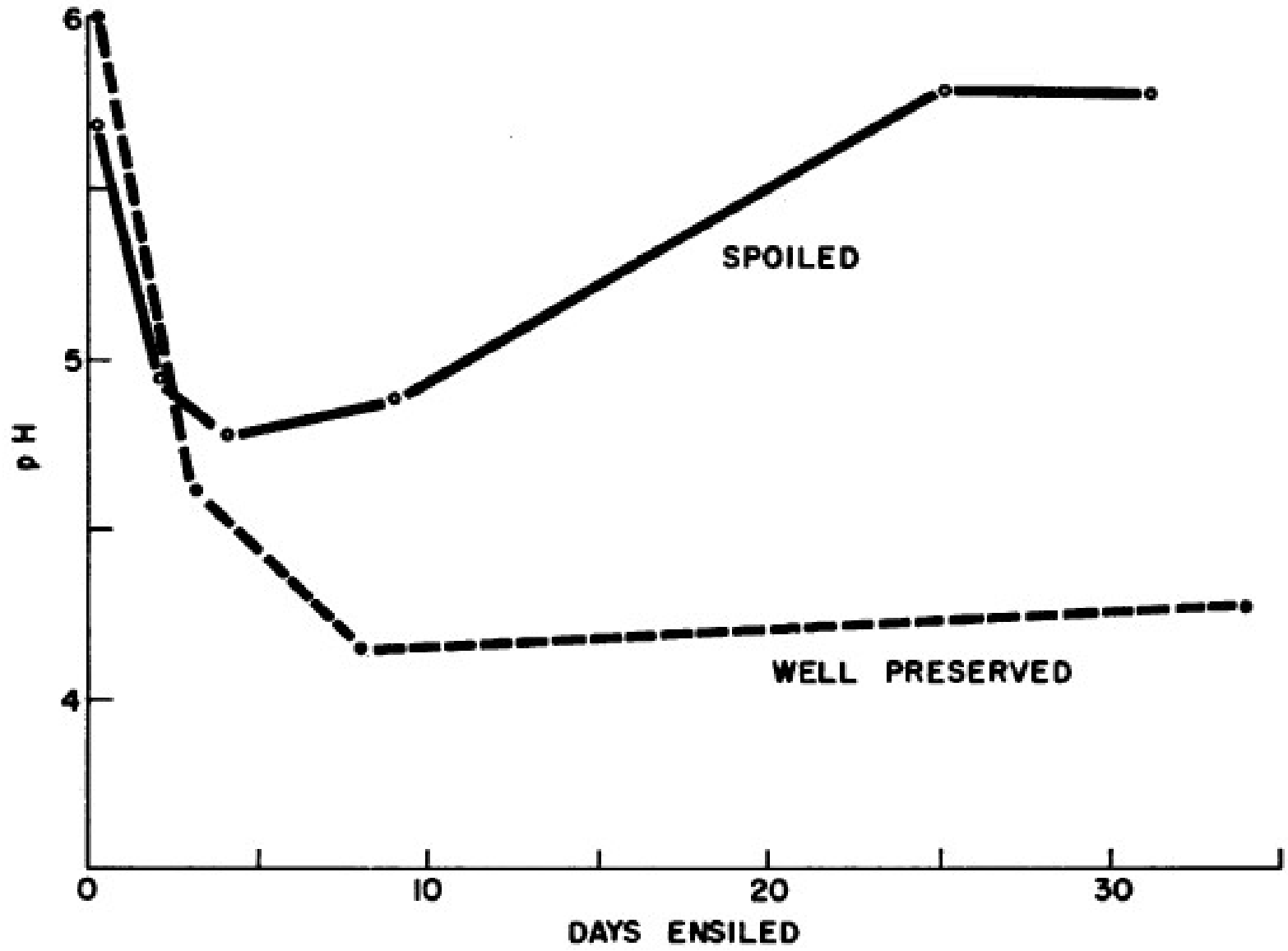


Figure 2. Comparison of pH changes in a well preserved silage and a spoiled silage. (A. G. KEMPTON4 AND C. L. SAN CLEMENTE, 1959)

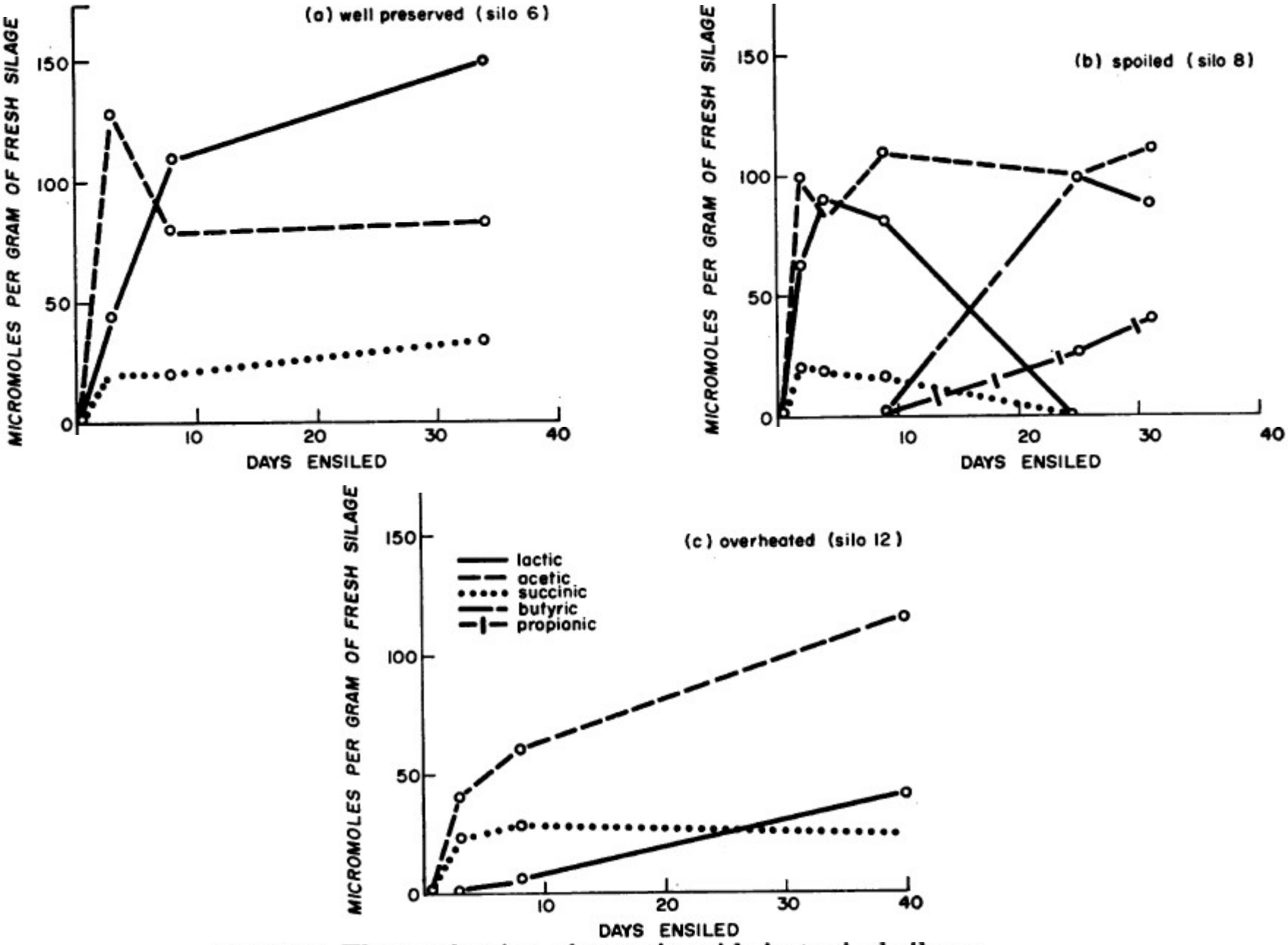


Figure 1. The production of organic acids in typical silages of different quality. (A. G. KEMPTON4 AND C. L. SAN CLEMENTE, 1959)

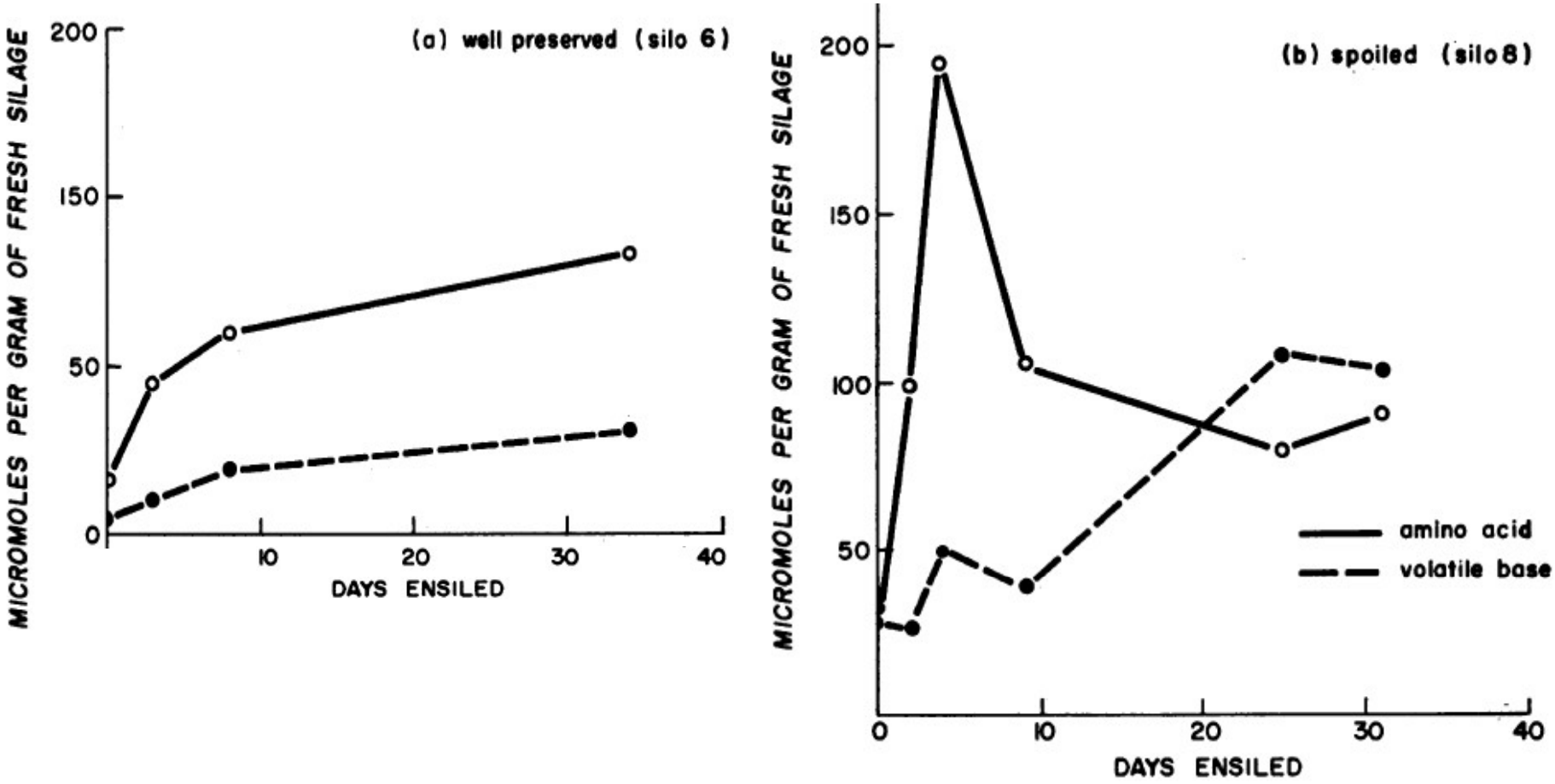


Figure 3. Comparison of the production of amino acid and volatile base in a typical well preserved silage and a spoiled silage. (A. G. KEMPTON4 AND C. L. SAN CLEMENTE, 1959)

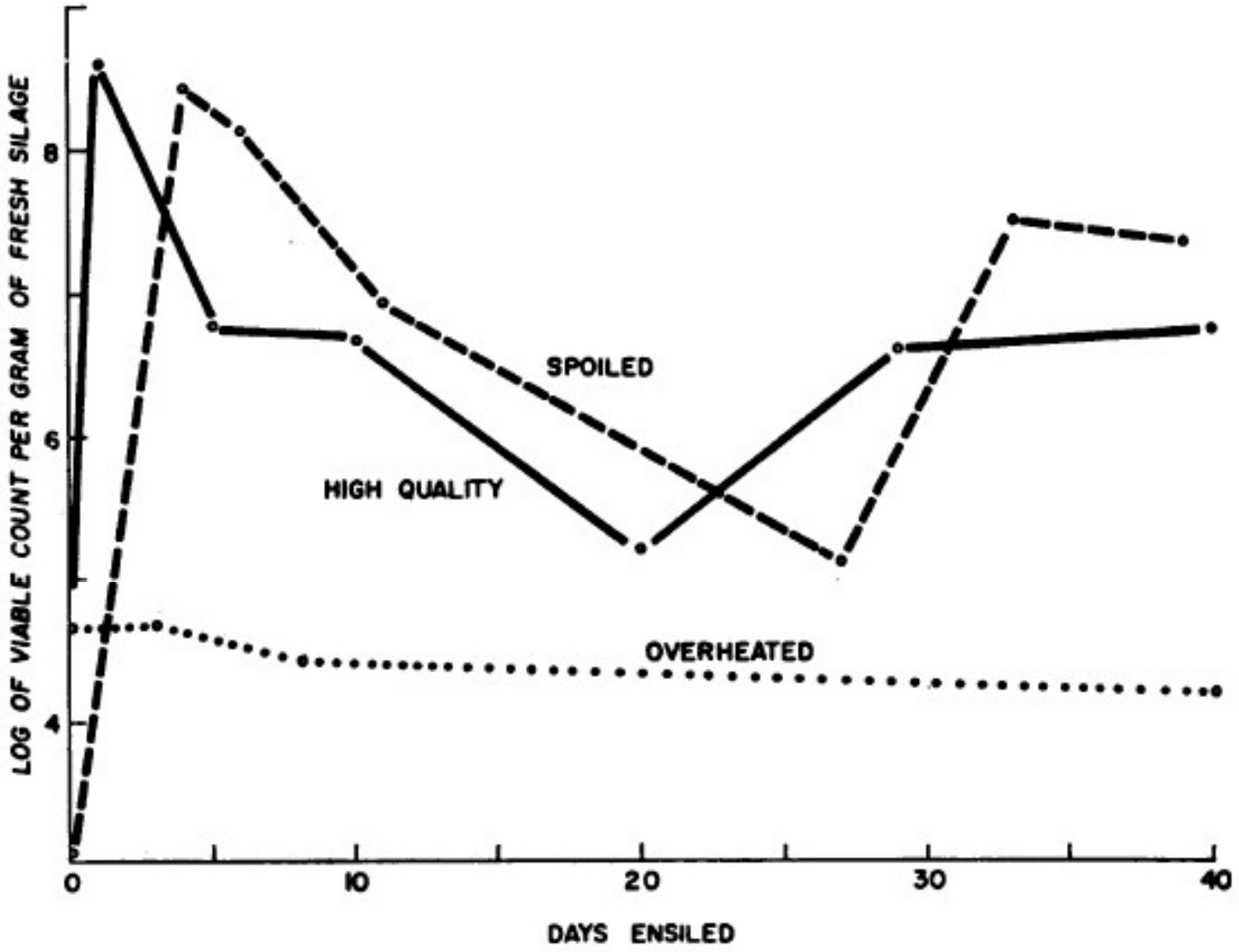


Figure 4. The population of lactic acid bacteria in typical silages of different quality.

(A. G. KEMPTON4 AND C. L. SAN CLEMENTE, 1959)

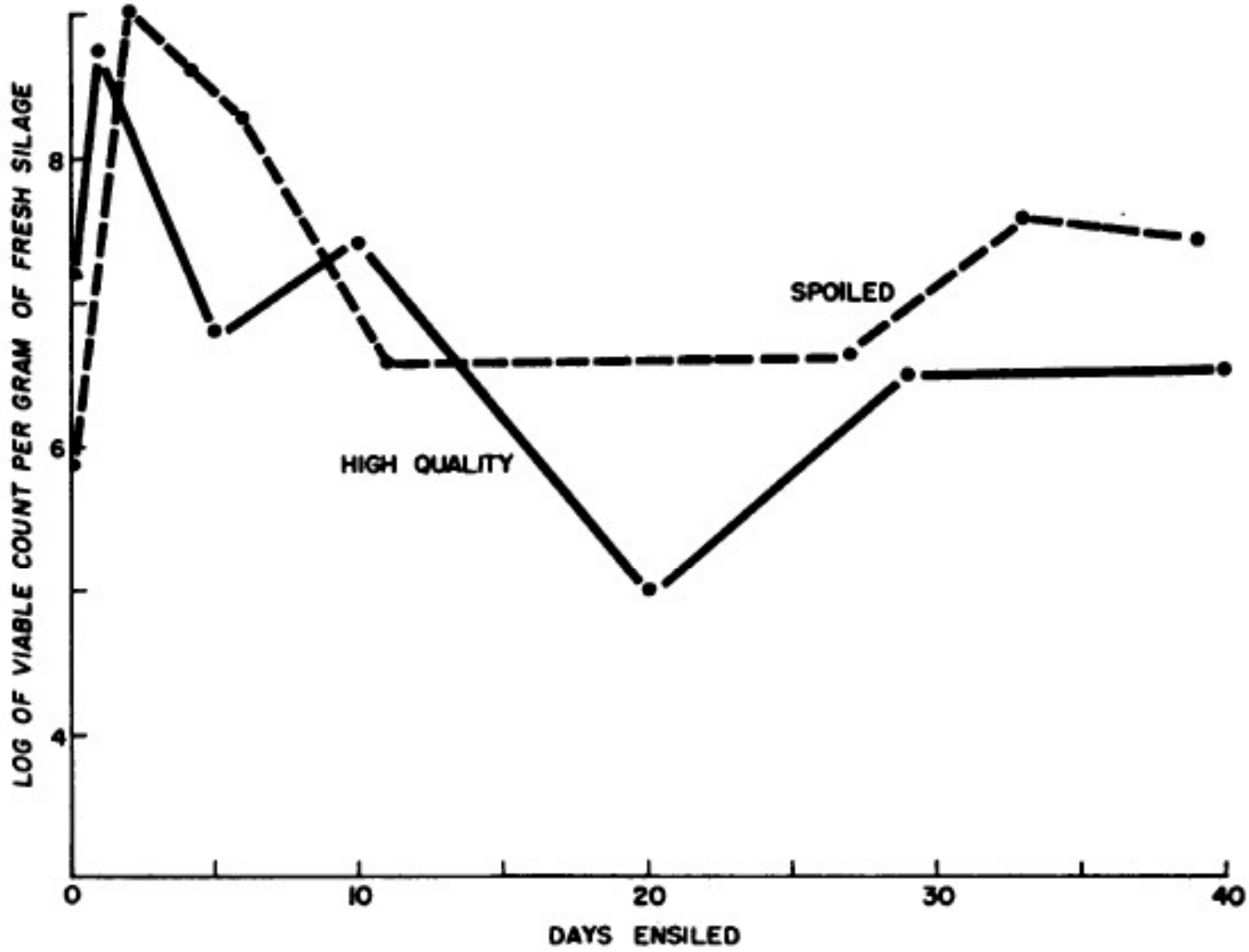


Figure 5. The total population of anaerobes in a typical well preserved silage and a spoiled silage.

(A. G. KEMPTON4 AND C. L. SAN CLEMENTE, 1959)

Microbiology of Silage

- The lactic acid bacteria are the most important agents of silage preservation, although they are not the only bacteria present in normal fermentations.
- Normally, very few lactic acid bacteria on fresh crops, but normally there were as many as 10^9 to 10^{10} per g within a day or two after ensiling.
- Although homofermentative rods carried out the main lactic fermentation, pediococci and streptococci were observed in the early stages of the fermentation, and heterofermentive rods predominated later in the storage period.
- The population of lactic acid bacteria can be modified by wilting, mincing (chopping) and other factors.
- Butyric acid was found to be associated with spoiled silage to the lactate-fermenting activity of *Clostridium tyrobutyricum*.
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THANKS