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Enzymatic Chillproofing and Beer Foam Stability Part III. Effects of Papain Concentration and Storage Condition

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酵素에 의한 除濁操作과 麥酒의 發泡性 第Ⅲ報 Papain 濃度와 貯藏條件의 影響

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Abstract

Freshly fermented green beer samples were chillproofed with reduced amounts of papain in order to avoid the deterioration of foam quality. Without being pasteurized, the bottled beer samples were stored at different temperatures for various days and then their foam stabilities were determined. A significant improvement in foam stability was observed in the beer chillproofed with 15 ppm of papain for 22 days at 0 °C and not pasteurized. The findings may be applied in the finishing processes for draft beer where pasteurization is not needed.

Introduction

The stable foam quality of freshly fermented green beer was observed to be destroyed drastically through the finishing processes of chillproofing and pasteurization[1]. A further study[2] proved that the enzymatc activity of papain which might be accelerated by the high temperature during the pasteurization process deteriorated the foam quality.

In the present study attempts have been made to reduce the degree of foam deterioration by limiting the amount of papain for chillproofing, elimination of pasteurization, and by storing the beer at a lower temperature.

Materials and Methods

Freshly fermented commercial green beer was chillproofed in 20-liter aluminum tanks with various concentrations of papain for 22 days at 0 °C. A commercial brand of "double strength" papain was used. After chillproofing, the beer was filtered and bottled. Pasteurzation was not applied for the beers of storage tests, but when needed it was done for 20 minutes at 60 °C. The bottled beer

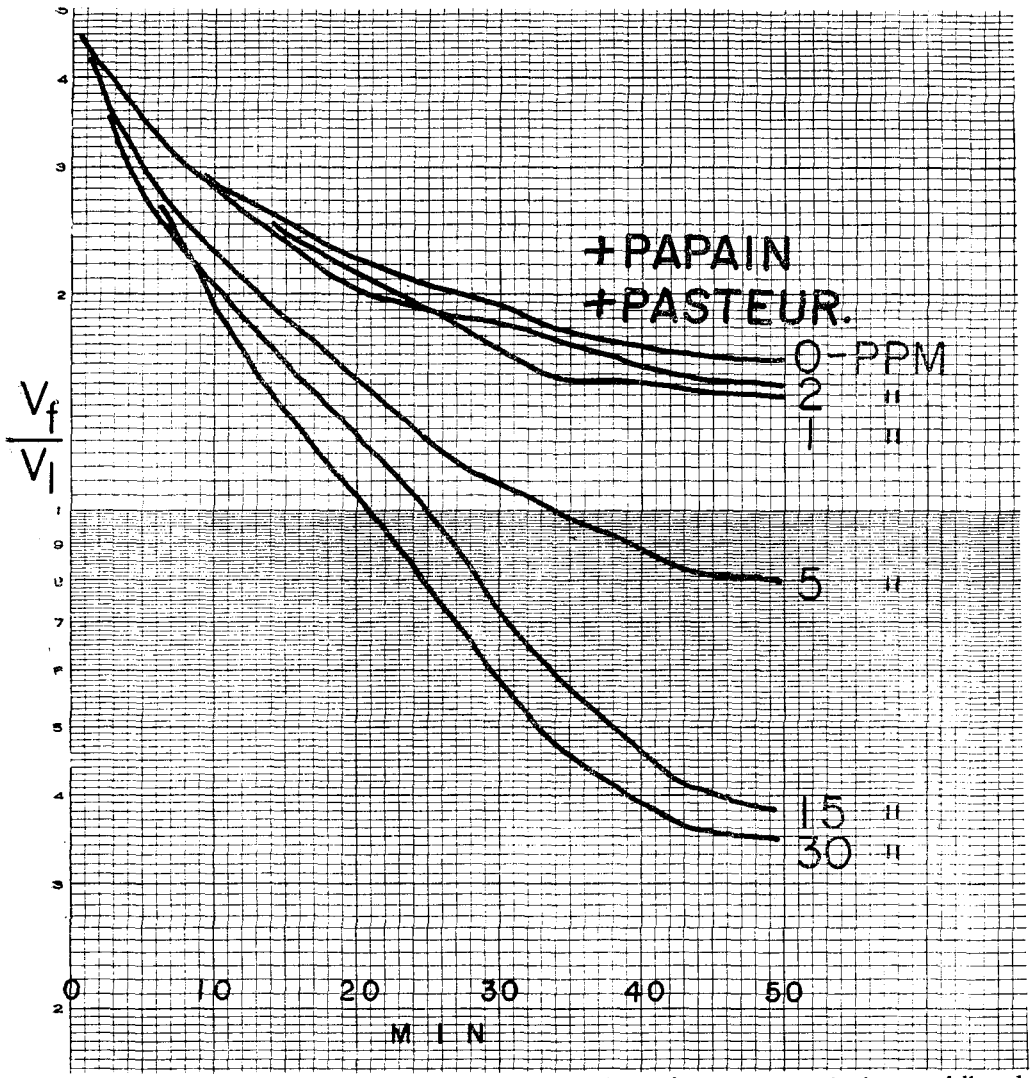

Fig. 1. Effect of Papain Concentration on the Foam Stabiliity of Beer. Pasteurizationwas followed after 22 days of chillproofing at 0°C with various concentrations of papain. V_f, V_l; Volumes of foam (V_f) and liquid beer (V_l) in the foam measuring device described previously(1).

samples were stood at 15 °C and 5 °C until their foam qualities were measured. The foam stability of the beer was expressed by the slope of the foam decay curve obtained through the procedures described previously[1]. The stability of a foam is inversely proportional to the slope of the curve.

Results

As can be seen in Fig. 1, the pasteurization process could not alter the foam stability if the papain was limited to 2ppm level. However, when the beer was treated with 5 ppm of papain under the same experimental conditions, the foam deterioration was significant, and became more drastic when the papain amount was tripled. However, the reduction of papain concentration could protect the foam stability substantially when the pasteurization process was not followed (Fig. 2).

The significant improvement of foam quality in

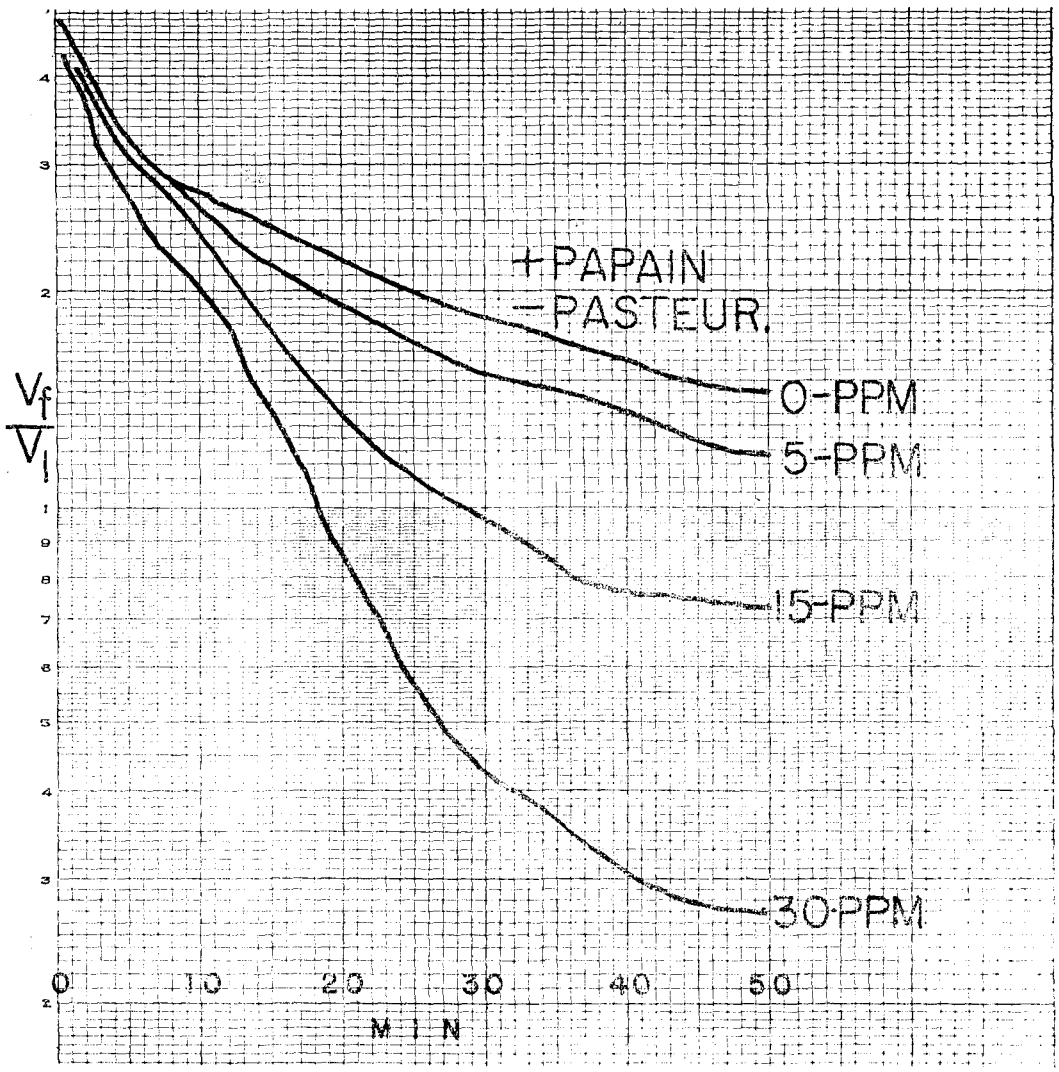

Fig. 2. Effect of Papain Concentration on the Foam Stability of Beer. Pasteurization was elliminated after 22 days of chillproofing at 0°C with various concentrations of papain.

the beer obtained from both attempts of reducing the papain concentration to 15 ppm and skipping the pasteurization was found to be lost again when the beer was stored at a temperature higher than the refrigeration (Fig. 3), A Complete destruction of foam stability was observed in the beer stored for 30 to 40 days at 15 °C. When the beer chillproofed with 15 ppm of papain was stored at the refrigeration temperature (5 °C), instead, the foam quality remained stable for a month or so (Fig. 4). When the papain concentratoin was further reduced to 5ppm level the foam stability was significantly improved even at the 15°C-storage (Fig. 5), and the storage time was no more effective when the beer was stored at 5 °C (Fig. 6).

Discussion

The superior efficiency of papain in chillproofing of beer has made the enzyme so popular since the time of Wallerstein's invention[3] that it is almost impossible to remove papain completely from the

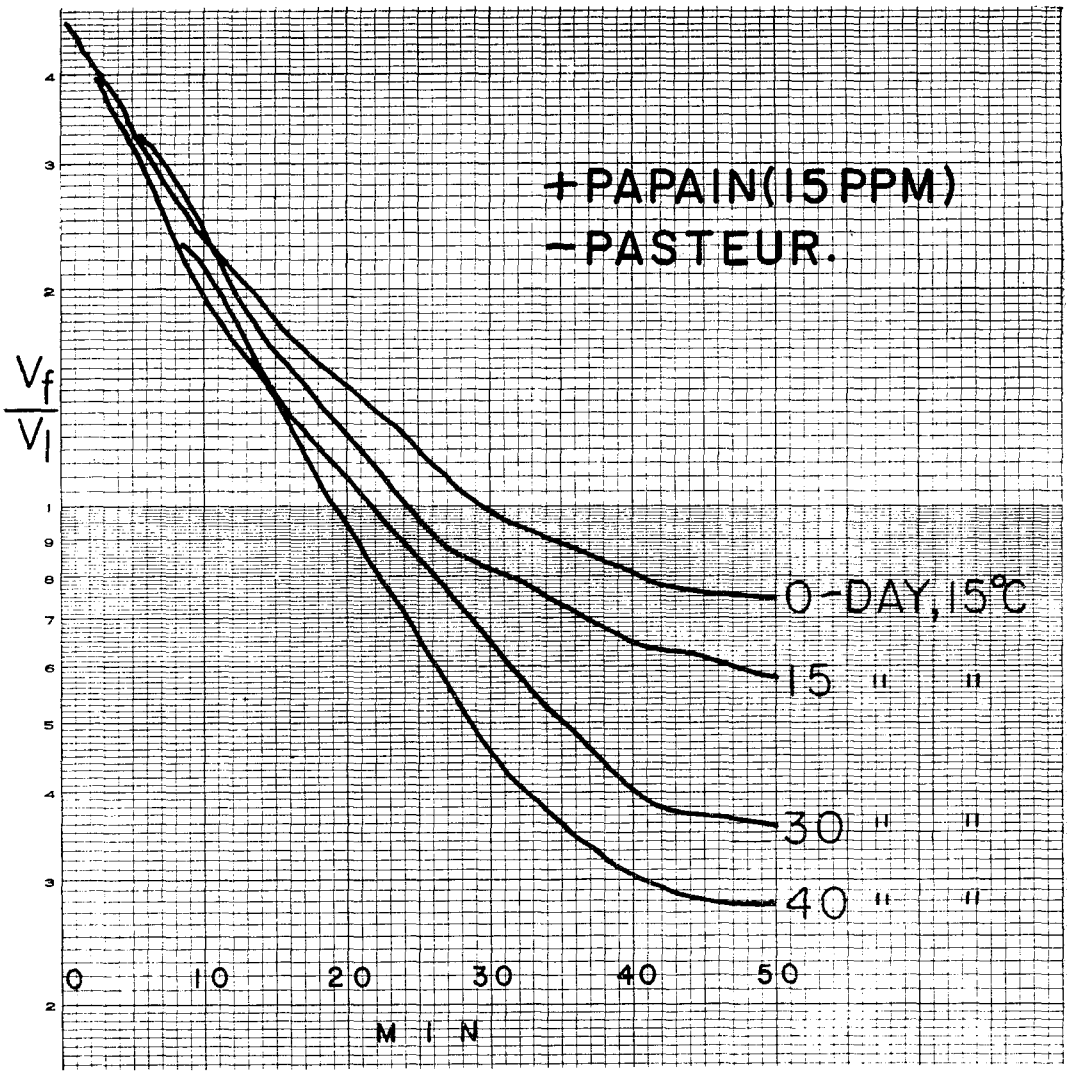

Fig. 3. Effect of Storage Condition on the Foam Stability of Beer Chillproofed with 15 ppm of Papain. Green beer was chillproofed for 22 days at 0°C and then without being pasteurized the beer was stored at 15° C for various days.

brewing industry. Trials to elliminate polyphenolic substances which are another essential components of haze particles in beer using various adsorbing materials such as nylon-66 powder (4, 5) and Polyclar-AT, an insoluble poly-N-vinyl pyrrolidinone (6, 7, 8, 9, 10) are still far from a practical use. Attempts have been made, therefore, to use papain with less deterioration of foam quality in the beer by limiting the amount of the enzyme to be applied. Reduction of the papain contentration to the one half (15ppm) of the normal use (30ppm), however, could not improve the foam stability as far as the pasteurization is accompanied (Fig. 1). Five ppm of papain, although it did not damage the foam quality, would not satisfy the chillproof ing purpose. Since the pasteurization process is not required in the manufacture of draft beer the experiments without pasteurization are worthwhile to consider. The stability of foam in the beer which was chillproofed with 15 ppm of papain and

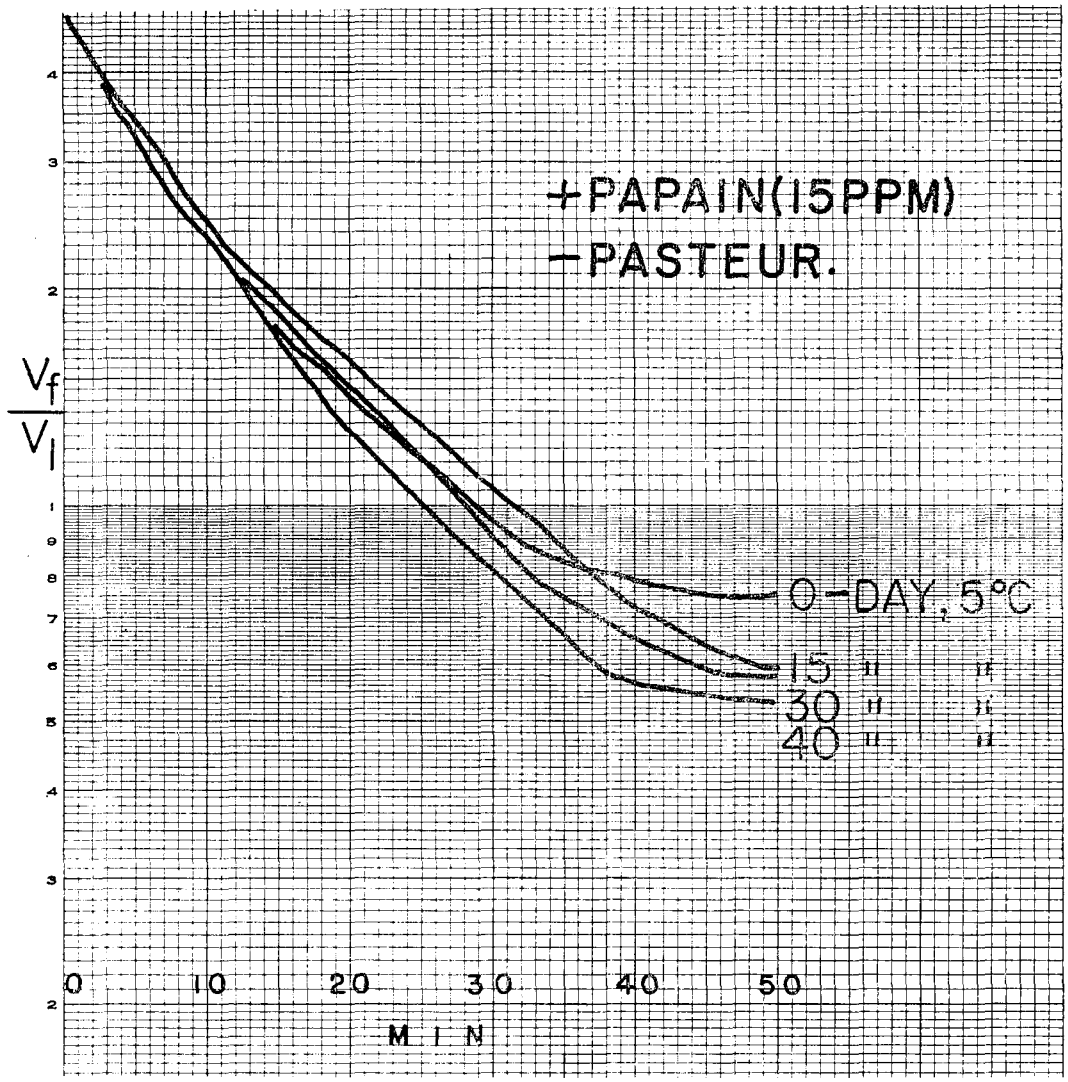

Fig. 4. Effect of storage Condition on the Foam Stability of Beer Chillproofed with 15 ppm of Papain. Green beer was chillproofed for 22 days at 0°C and then without being pasteurized the beer was stored at 5 °C for various days.

stored at 5 °C without being pasteurized (Fig. 4) is encouraging, because draft beer is usually stored in the refrigerator until consumed. Furthermore, the beer was stable at 15 °C for half a month (Fig. 3) and this will ensure the foam quality of draft beer against possible temporary exposure to a higher temperature during transporation between the factory and consumers' refrigerators.

要　約

新鮮한 풋麥酒를 發泡性의 損失을 피하기 위해 적은 量의 Papain으로 除濁시켰다. 麥酒를 병에 넣은 다음 滅菌은 시키지 않고 溫度와 時間을 달리하여 貯藏 시킨다음 發泡性을 調査해 보았다. 15 ppm의 papain으로 0 °C에서 22日동안 除濁시키고 滅菌을 하지 않았을 경우에 麥酒의 發泡性이 현저히 좋아졌다. 이 事實은 滅菌을 하지 않는 生

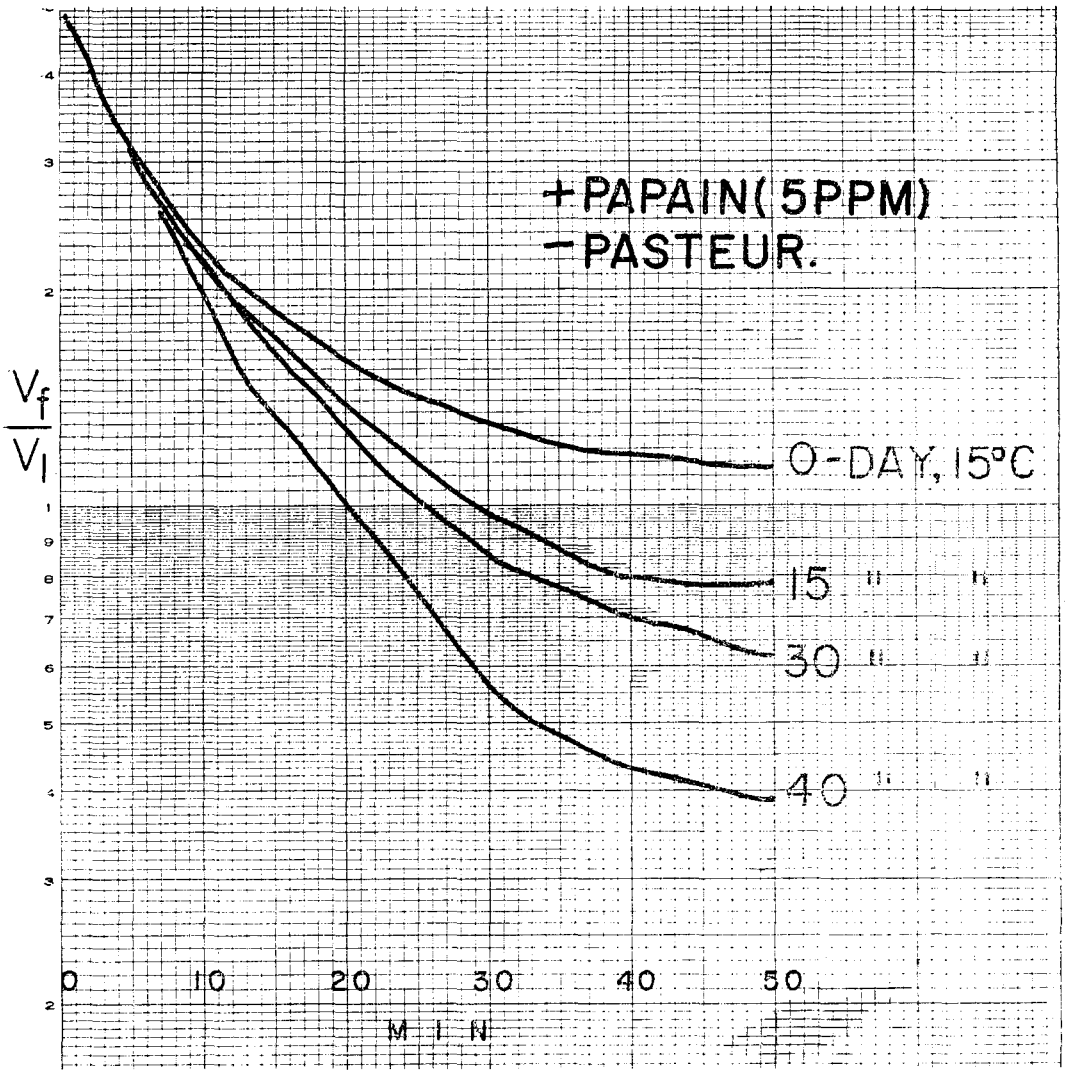

Fig. 5. Effect of Storage Condition on the Foam Stability of Beer Chillproofed with 5 ppm of Papain. Green beer was chillproofed for 22 days at 0° C and then without being pasteurized the beer was stored at 15° C for various days.

麥酒製造에 利用될 것으로 본다.

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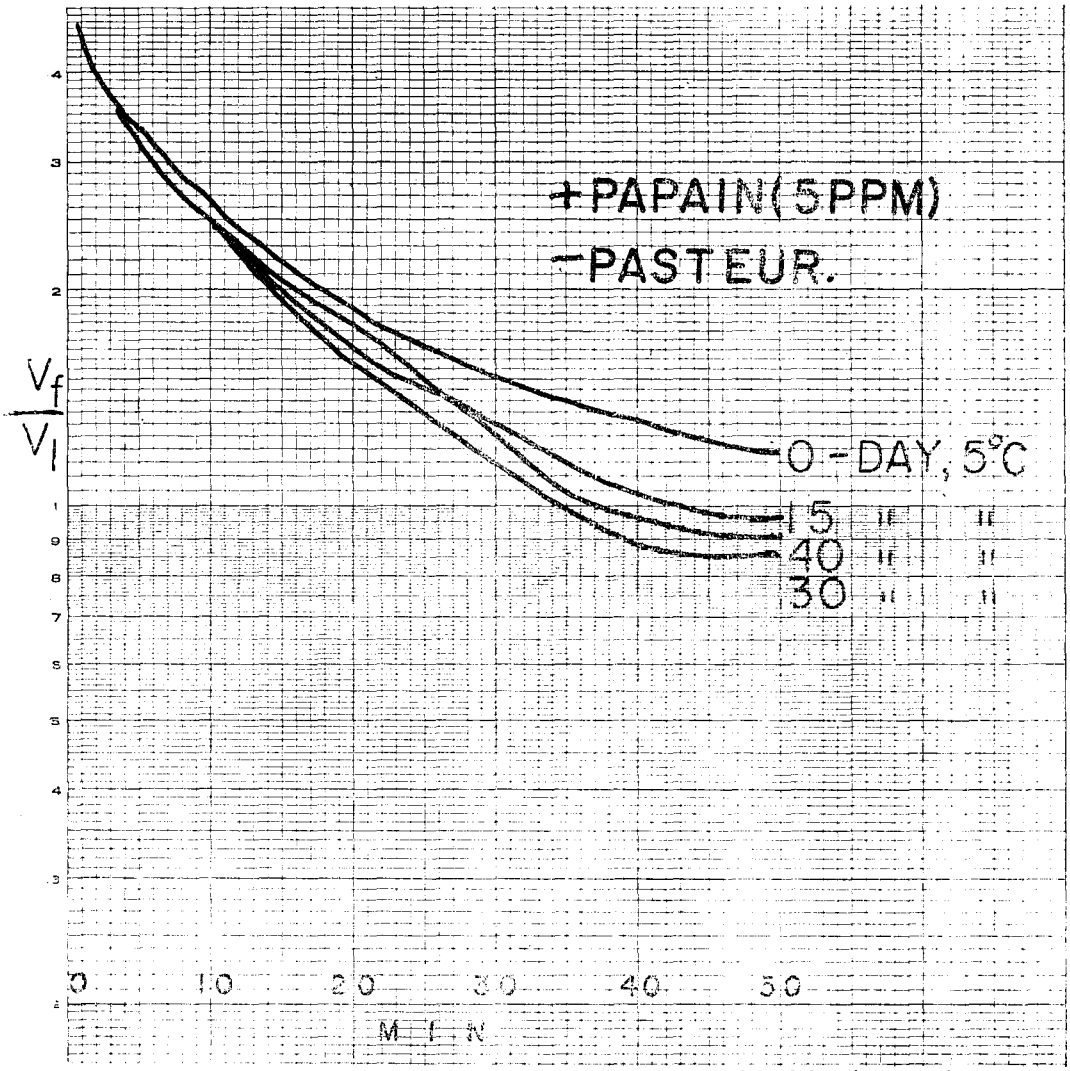

Fig. 6. Effect of Storage Condition on the Foam Stability of Beer Chillproofed with 5ppm of Papain. Green beer was chillproofed for 22 days at 0°C and then without being pasteurized the beer was stored at 5°C for various days.

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