

### Role of garlic on the growth and lactic acid production of meat starter cultures in Nham (thai fermented meat)

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**Introduction :** For decades, starter cultures are widely used for producing various fermented meat products in order to shorten the ripening period, ensure colour development, enhance the flavour and improve product safety [1, 2]. Nham, thai traditional fermented pork, is a kind of fermented meat product. Thus, the attempt of using starter cultures for improving the quality of this product was also studied [3, 4]. The product of Nham with starter cultures was reported more advantage in quality improvement, and an organoleptic tests by both consumers and producers were shown more preference than naturally fermented product [3, 4]. Many publications reported that natural spices such as garlic, which was used as an ingredient for this thai fermented meat product, gave some effects on the growth of lactic acid bacterial (LAB) starter cultures and accelerated the fermentation process in various meat products [5, 6, 7]. So it was of importance to find out whether garlic affects the fermenting bacteria used in this thai typical fermented product. Thus, the presented work deals with the effect of fresh garlic on the fermentation properties of some commercial LAB starter cultures (*Lactobacillus sake*, *L. curvatus* and *Pediococcus acidilactici*) in Nham. In order to reproduce the homogeneous structure instead of Nham and various parameters under aseptic conditions without interference of other lactic acid producing flora such as coliforms, the same study was also done in a developed model broth and simulating the conditions in Nham.

#### Materials and Methods

**Starter cultures :** Three strains *L. curvatus*, *L. sake* and *P. acidilactici* of commercially available starter cultures from Gewürzmüller GmbH, Stuttgart, Federal Republic of Germany were used for this study.

**Liquid medium :** MRS broth - medium modified [8] was used as cultivation medium for the study LAB.

: Nham model broth (10 g meat extract, 10 g tryptone, 0.5 g sodium ascorbate, 3 g sodium tripolyphosphate, 10 g glucose, 25 g NaCl and 0.125 g sodium nitrite, 1 L distilled water) was used to simulate the product of Nham. The conditions during fermentation for this model broth (pH,  $a_w$ , microaerophilic, temperature) were also simulated the fermentative conditions in Nham.

**Preparation of fresh sterilized garlic :** Local unpeeled garlic bulbs were used to prepare fresh sterilized garlic. The cloves were gently peeled, washed thoroughly with sterile distilled water, soaked in 70% ethanol for 30 minutes and washed thoroughly with sterile distilled water. Five percent of sterilized garlic was aseptically cut in small pieces and transferred into the sterilized Nham model broth.

**Preparation of Nham :** The recipe of Nham (650 g minced meat, 350 g shredded cooked pig skin, 60 g cooked rice, 25 g salt, 3 g sodium tripolyphosphate, 0.5 g sodium ascorbate, 0.125 g sodium nitrite) with and without 50 g shredded fresh garlic was prepared. Both raw mixed ingredients of Nham samples with and without garlic were inoculated with each strain of commercial LAB at a level of about  $10^6$  cells/g and well mixed. Nham mixture was stuffed into 35 mm plastic casings. The weight of each sample was approximately 125 g. All Nham samples were transferred to a drying chamber with a temperature of 30 °C and 92 % relative humidity, and were left to ferment for 3 days.

**Microbiological and chemical analysis :** The samples of both Nham model broth and Nham product (with and without garlic) were examined daily for enumerating LAB growth [9], and were determined for pH and  $a_w$  [3, 4], percentage of acetic acid and lactic acid production [10].

#### Results and Discussion

Determination of some chemical properties during 0-3 days of Nham fermentation revealed that water activity of all samples was between 0.967-0.970. The results for lactic acid and pH (Figure 1) showed that samples with starter cultures had higher lactic acid amounts which resulted in lower pH than the naturally fermented samples. The advantage of using both garlic and starter cultures in speeding lactic acid production and lowering the pH was indicated. These two factors, however, showed a better result in lowering acetic acid production (0.02-0.09 %) than the products without both of garlic and starter cultures (0.14 %), which could prevent an undesirable off-flavour in this product [7, 10].

Figure 2 revealed that, in all tests performed, an increase of lactic acid production was accompanied by an increasing number of LAB. All samples with garlic gave a better result in LAB growth and also exhibited much better in lactic acid production than those of without garlic. The results also showed the advantage of using all studied commercial starter cultures for higher lactic acid production compared to those of naturally fermented samples. The comparison between the starter cultures in Nham showed that *L. sake* had the best results in lactic acid production and *P. acidilactici* had the least.

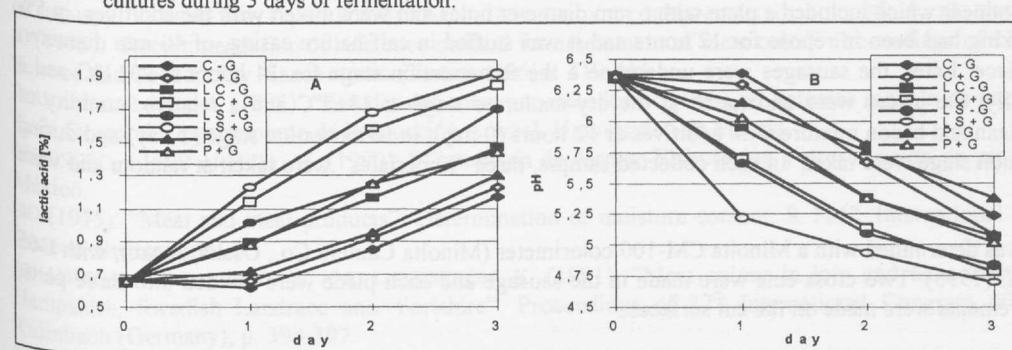
The same study of some effects from fresh garlic on the studied commercial LAB was conducted by creating Nham model broth and simulating the conditions in Nham. The results in Figure 3 indicated that the addition of garlic in Nham model broth achieved also better results in lactic acid production and lowered the pH among all studied LAB than those of without garlic. The use of these three strains of LAB for Nham model broth fermentation also produced very low concentration of acetic acid (< 0.05 %). Adding of 5 % fresh garlic in this model broth also enhanced the growth of all studied LAB and their lactic acid production (Figure 4). Beneficial results of garlic in various fermented meat products to stimulate the growth of LAB and their lactic acid production, which reported in this study, concurred to many earlier reports [5, 6, 7].

**Conclusions :** Thus with all the presented data, we definitely trust that the addition of garlic is not only for flavour development in Nham product, but it also possesses stimulatory activity and influences the growth of LAB. Together with these results, we feel confident to rely on data obtained using these three commercial LAB as starter cultures for quality improvement of this thai fermented meat product.



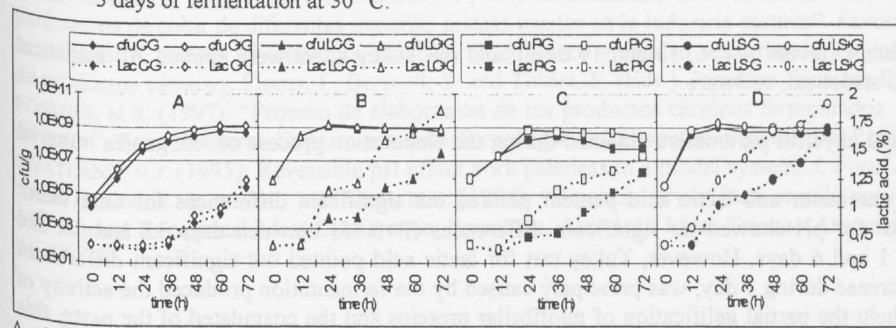
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**Figure 1 :** Lactic acid (A) and pH (B) of Nham (with and without garlic) fermented with and without starter cultures during 3 days of fermentation.



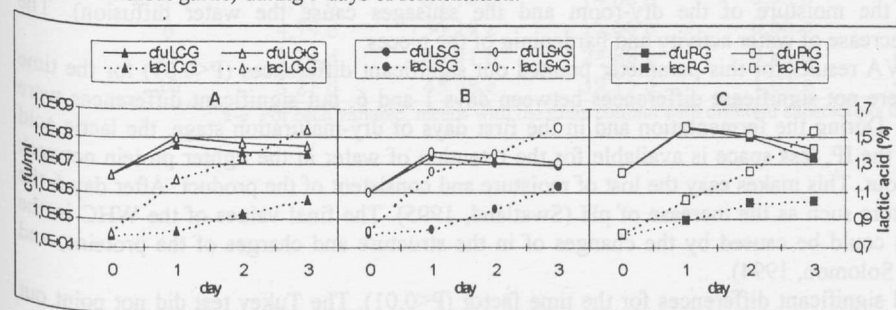
C = naturally fermented, LC = fermented with  $10^6$  cells/g of *L. curvatus*, LS = fermented with  $10^6$  cells/g of *L. sake*, P = fermented with  $10^6$  cells/g of *P. acidilactici*, -G = without garlic, +G = with 5% garlic

**Figure 2 :** Growth of LAB and percentage of lactic acid in Nham (with and without garlic) during 3 days of fermentation at 30° C.



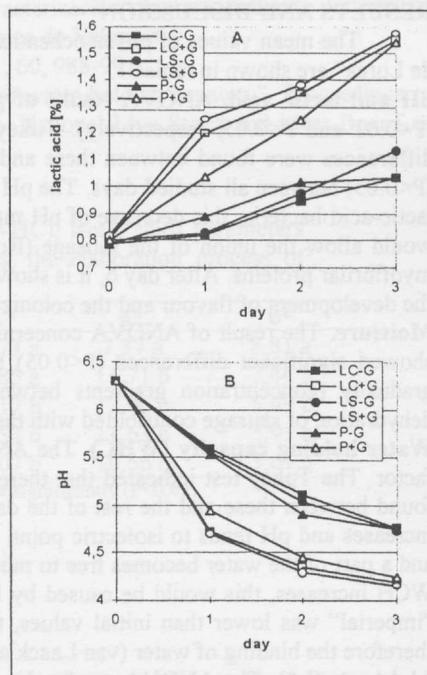
A = Nham without starter, B = Nham with *L. curvatus*, C = Nham with *P. acidilactici*, D = Nham with *L. sake*, cfu = colony forming unit, Lac = lactic acid production (%), -G = without garlic, +G = with 5% garlic

**Figure 4 :** Growth of LAB and percentage of lactic acid in Nham model broth (with and without garlic) during 3 days of fermentation.



A = Nham model broth with *L. curvatus*, B = Nham model broth with *L. sake*, C = Nham model broth with *P. acidilactici*, cfu = colony forming unit, lac lactic acid production (%), -G = without garlic, +G = with garlic

**Figure 3 :** Lactic acid (A) and pH (B) of Nham model broth (with and without garlic) fermented with various starter cultures during 3 days of fermentation.



LC = fermented with  $10^6$  cells/g of *L. curvatus*, LS = fermented with  $10^6$  cells/g of *L. sake*, P = fermented with  $10^6$  cells/g of *P. acidilactici*, -G = without garlic, +G = with 5% garlic