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ROUNGDAO MAUNGMA : STUDY ON THE MAILLARD REACTION IN THAI SOY SAUCE. THESIS ADVISORS : SITTIWAT LERTSIRI, Ph.D., AMARET BHUMIRATANA, Ph.D., APINYA ASSAVANIG, Ph.D., 158 P. ISBN 974-664-164-6

It is well known that the Maillard reaction, or nonenzymatic browning reaction in foods and biological systems is a very complex reaction which stems from the interaction between amino compounds and reducing sugars. In soy sauce, the Maillard reaction is known as the main cause of the dark brown color and the characteristic flavor formation. Despite many studies, which have tried to explain the mechanism of the Maillard reaction in Japanese soy sauce, the results did not represent soy sauce manufactured in other regions due to the variation in ingredients and processing conditions.

The Maillard reaction occurring during processing and storage of two conventional Thai soy sauces were investigated for the chemical changes of browning, reducing sugar (RS), reactive amino group (RAG), 5% TCA-precipitated protein (PP), Amadori products (ARP), and 5-hydroxymethyl furfuraldehyde (HMF). The development of the Maillard reaction during moromi fermentation was a 2-stage consecutive mechanism. During the first stage (i.e., the first 3 days of fermentation), browning, RS, RAG, and ARP increased rapidly while pH decreased. In the second stage, these changes occurred slowly. During fermentation, the increase of HMF was the index of the progress of the Maillard reaction. After the moromi fermentation, raw soy sauce, pasteurized soy sauce (without seasoning), and cooked soy sauce (seasoned and pasteurized) were studied for the duration of the Maillard reaction during storage at 37°C for 3 months. The Maillard reaction in raw soy sauce continued progress in a similar pattern as in moromi fermentation, while HMF and PP highly accumulated in cooked soy sauce during storage. This suggested that seasoning and heat treatment of the soy sauce product enhanced the progress of the Maillard reaction.

The effects of brine concentration and aeration on the progress of the Maillard reaction were investigated during moromi fermentation (20 days). Koji was fermented in brine at 18, 20, 22, and 24% (w/v) salt. The Maillard reaction occurred in the same pattern as previously reported. Brine concentration did not affect on the progress of the Maillard reaction during fermentation, except the 24% brine gave higher amounts of PP. To investigate the involvement of oxidative browning during moromi fermentation, the moromi in 20% brine was aerated at 20 ml/min for 20 days and then compared with the non-aerated system. Although the aeration did not affect brown color development, it influenced the low RS, RAG, PP, total soluble protein (SP), and pH and caused the turbidity of the system. Thus, the oxidative browning was not apparently involved with the Maillard reaction to develop the brown characteristic of Thai soy sauce.

When compared with Japanese soy sauce during storage test, both of the Thai soy sauces had an excess of RS, while the Japanese soy sauce had an excess of RAG and the accumulation of HMF was the important index for the progress of the Maillard reaction. The increase of RS in Thai soy sauce during the storage test was confirmed by the sugar analysis by HPLC. Arabinose, xylose, glucose, and sucrose were present in all samples of soy sauce. The arabinose and xylose types of 5C sugar were involved in the progress of the Maillard reaction in Thai soy sauce and Japanese soy sauce, respectively.

The presence of metal ions (Fe^{2+} , Fe^{3+} , and Cu^{2+}) and potassium iodide (KI) in soy sauce at various concentrations did not directly affect the Maillard reaction during storage. However, Fe^{2+} caused a high accumulation of PP and a high loss of ARP while KI caused less PP. Hence, KI could be added as an iodine supplement in soy sauce without enhancing the Maillard reaction.