3.2.2 Moisture content, water activity, texture, and pH: The moisture content and water activity of premix fruitcake and rice fruitcake decreased significantly over time at both storage conditions (Figure 21 to 24)

The decrease of moisture content and water activity was more pronounce at the storage condition of 30ºC and 75%RH than that at the storage condition of 20°C and 68%RH. It is suggested that higher temperature caused more moisture transfer. In addition, the temperature distribution in the product could also affect the moisture movement (Baik *et al*., 2000). Migration of moisture at macroscopic level, which could continuously occur for several weeks, was responsible for the loss of product quality. The water activity gradient between the dough and dried fruit may become larger at higher temperature. The starchy products' moisture content is lower at higher temperatures for the same water activity. This may cause an even larger activity gradient along the flour and fruit interface at high temperature, which facilitates the faster transport of water from the dough to the fruits. The dough became to dry. The diffusion and equilibrium of water in dough and fruit mixtures were explained by Karathanos (1995).

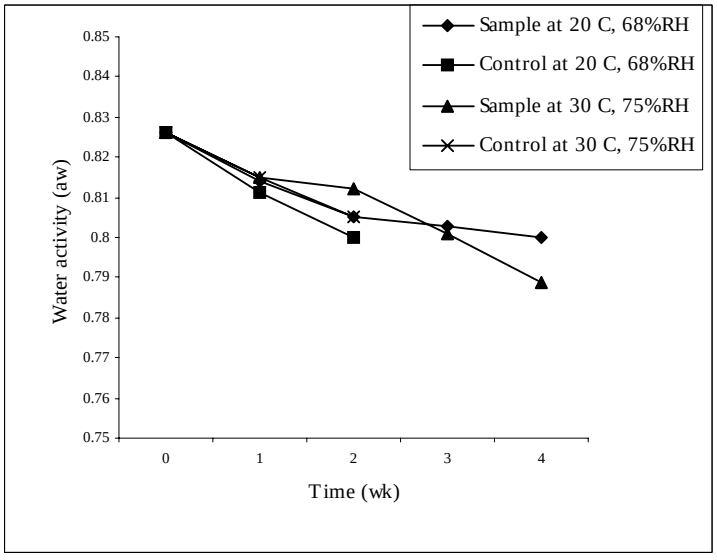

Figure 21 Water activity of premix fruitcake (PMC_5) at 20 ºC, 68%RH and 30 ºC, 75%RH

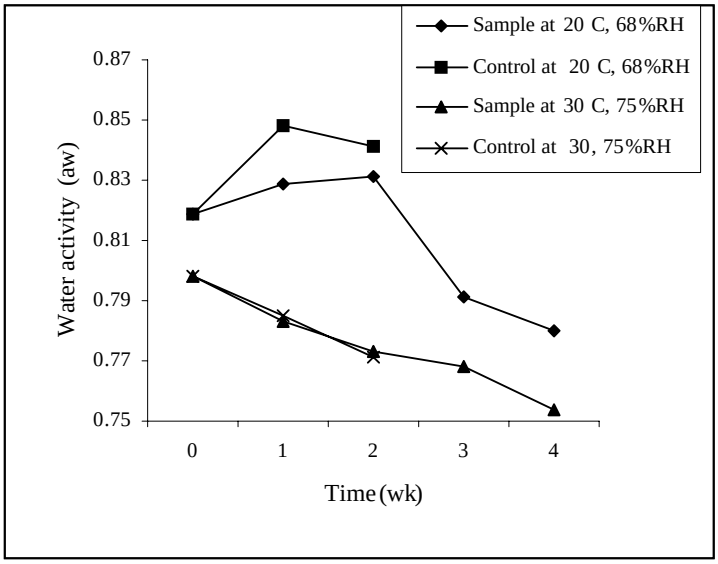

Figure 22 Water activity of rice fruitcake (RF) at 20 ºC, 68%RH and 30 ºC, 75%RH

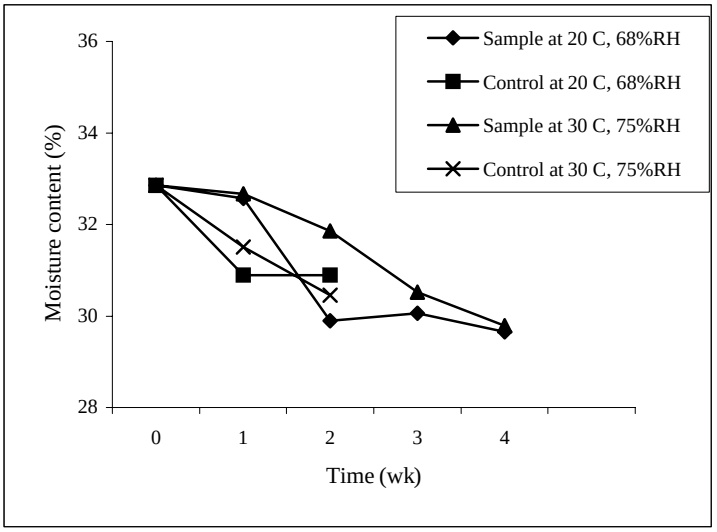

Figure 23 Moisture content of premix fruitcake (PMC_5) at 20 ºC, 68%RH and 30 ºC, 75%RH

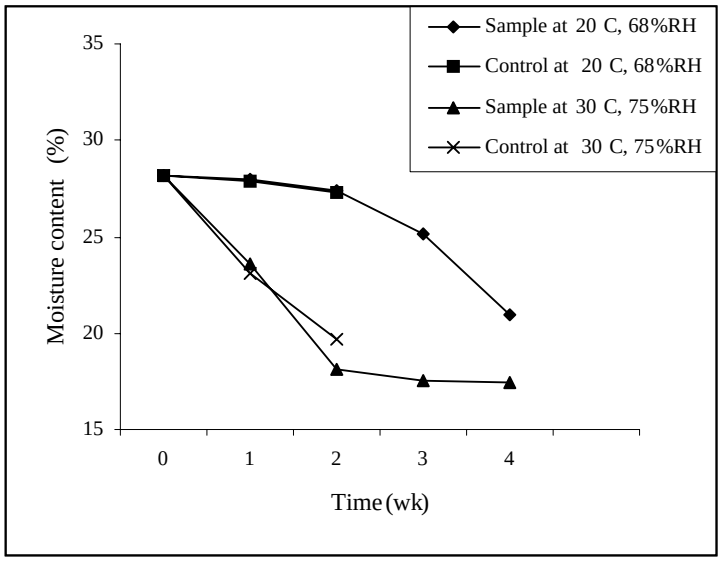

Figure 24 Moisture content of rice fruitcake (RF) at 20 ºC, 68%RH and 30 ºC, 75%RH

3.2.3 The pH

The pH of premix fruitcake changed during storage from 6.6 to 5.7 at 30°C, 75%RH and 6.6 to 5.5 at 20°C, 68%RH. The pH of rice fruitcake changed slightly during storage from 5.58 to 5.60 at 30°C, 75%RH and up to 6.18 at 20°C, 68%RH (Figure 25 and 26).

The pH is one of important factors to control the growth of microorganism. Guynot *et al* (2004) studied the combined effect of modified atmosphere packaging (MAP) and potassium sorbate (PS) on the preservation of a typical Spanish cake (sponge cake). All different combinations of PS concentration and MAP were more effective at pH 6 than at 7.5. Control air-packaged bags with 0.2% of PS showed visible growth after 6 days, at pH 6 and 0.90 a_w.

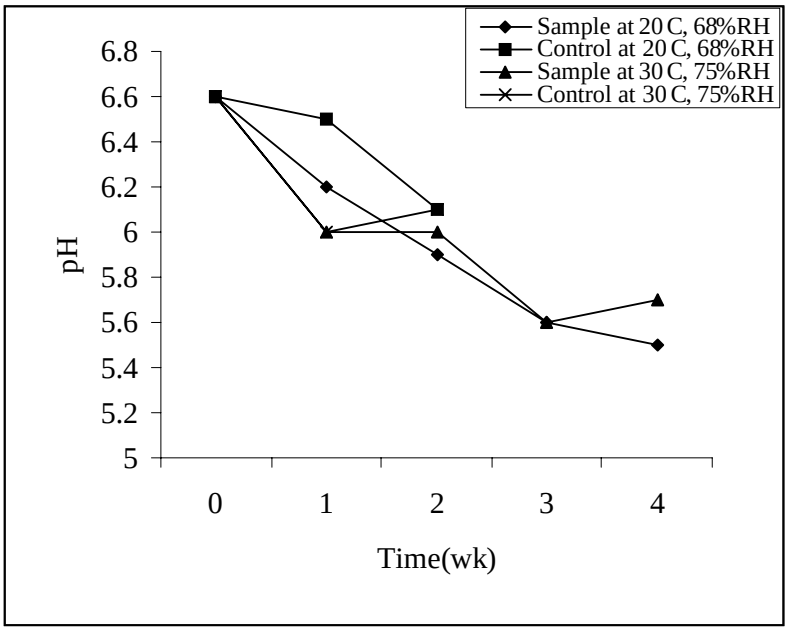

Figure 25 pH of premix fruitcake (PMC_5) at 20 ºC, 68%RH and 30 ºC, 75%RH

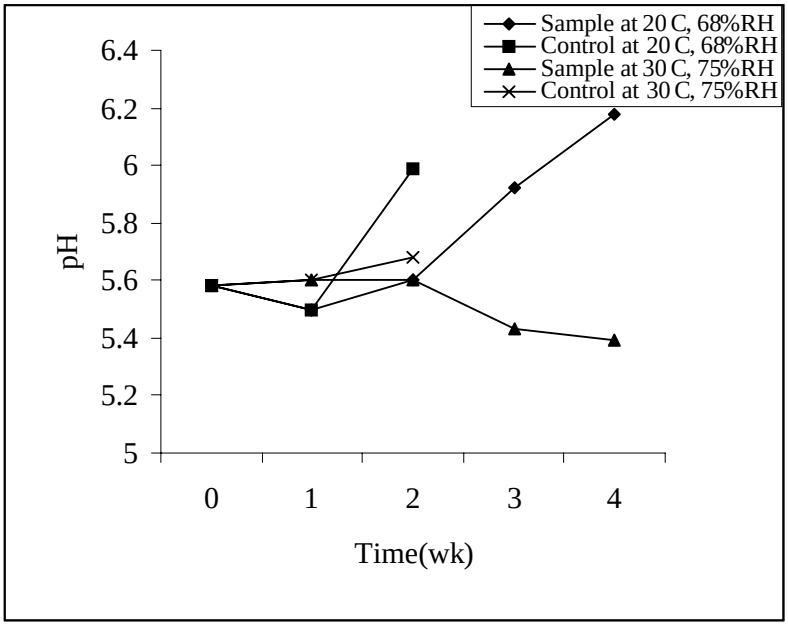

Figure 26 pH of rice fruitcake (RF) at 20 ºC, 68%RH and 30 ºC, 75%RH

3.2.4 The texture

The textures characteristic of premix cake and rice fruitcake are shown in Tables 18 and 19. Changes in the moisture content of flour and fruit mixed during storage could affect the quality of texture. The hardness and gumminess were lower while the adhesiveness and chewiness of premix fruitcake were higher with increasing duration of storage.

3.2.5 Fruitcake extract

The main compounds found in premix fruitcake extract (PMC_5) were *p*-cymene (5 –245 ppm), linalool (0-210 ppm), cinnamaldehyde (0-85 ppm), and eugenol (0-37 ppm). All of compounds showed a peak concentration at 21 days and significantly decreased after 28 days except eugenol. The *p*-cymene had the highest concentration, followed by linalool then cinnamaldehyde, and eugenol. Benjilali *et al* (1984) reported that the *p*-cymene was the lightest compound and could give higher concentration above essential oil headspace compared with heavier compounds e.g. phenolic compounds (Figure 27).

The main compounds found in rice fruitcake extract were *p*-cymene (12 –239 ppm), linalool (25-160 ppm), cinnamaldehyde (15-90 ppm), and eugenol (0 to 55 ppm). The *p*-cymene had the highest concentration, followed by linalool then cinnamaldehyde, and eugenol. The essential oil compounds need to transfer through the sachet material to high barrier bag headspace and then by adsorbed at the surface of rice fruitcake, this process likely explaining the increase of the compounds in the cake after 21 days. The rapid decrease after 21 days is more difficult to explain, but could be due to transfer through the high barrier bag (Figure 28).