ABSTRACT
Flavonones are a flavonoid subclass common to citrus fruits. Flavonoids including flavonones may be of benefit to human health through their radical scavenging and antioxidant properties. Orange juice is the foremost food that provides flavonones in the diet. The predominant flavonones in pure orange juice are hesperetin and naringenin glycosides. Globally, the total consumption of pure orange juice out of all orange juice products such as fruit juice, nectar, and juice drinks was 4% in 2011. The goal of this study was to examine the effects of pasteurization and concentration on hesperetin and naringenin content in 100% juice made from sweet oranges (Citrus sinensis L.). Studies from different countries that analyzed pure orange juices processed using different methods were collected through a scientific literature search. Analytical values for hesperetin and naringenin contents in these juices were compared to examine processing effects. Three processing techniques (e.g., domestically-squeezed, pasteurized-not-from-concentrate, and pasteurized-made-from-concentrate) and flavanone content in 100% sweet orange juice were compared. Twenty studies from the U.S., EU, and Brazil where researchers analyzed flavanones in 100% orange juice (Citrus sinensis L.) were retrieved. Results for hesperetin weighted mean values in 100% orange juice pasteurized-from-concentrate, pasteurized-not-from-concentrate and domestically-squeezed were 17.7±12.50, 10.92±7.86, and 11.04±3.18 mg/100g respectively. For naringenin values were 3.0±0.36, 2.3±0.32 and 3.4±0.37 mg/100g respectively. Concentration may have a significant positive correlation with hesperetin content, whereas there was no significant change in naringenin content observed after pasteurization. Concentration may have a significant positive correlation with naringenin content, whereas pasteurization may have a negative correlation with naringenin content in orange juice.

INTRODUCTION
Citrus flavonones are a subclass of flavonoids with polyphenolic structures, see Figure 1 (USDA, 2011). They are secondary plant metabolites that play a role in plant defense mechanisms. In commercial citrus species like oranges flavonones tend to be in the flower and leaf tissues with slightly higher concentrations in the leaf, see Figure 2 (USDA, 1998). Clinical trials and epidemiological studies show the consumption of flavonoids like hesperetin and naringenin glycosides may lead to health promoting effects. In human clinical trials and random crossover studies hesperetin glycosides have been shown to have significant cardio-protective effects (Gang et al., 2011; Manthey et al., 2001; Manthey et al., 2001). Hesperetin may slow down the progression of bone loss by reducing osteoclasts cells and bone resorption (La et al., 2009). The quantity of sweet orange (Citrus sinensis L.) and the processed products consumed make it among the most popular fruits in the world, and its economic and nutritional value (Liu et al., 2012). In 2010-2011, the world produced 3.3 billion gallons of orange juice where Brazil produced the most at 62% of the world production followed by United States (27%), Mexico (4%), European Union’s 27 member states (3%) and “Other” (3 %) (USITC, 2007). Almost 80% of orange juice consumed in the U.S. is from domestic sources especially from Florida with remaining imports mostly of Brazilian origin (Li et al., 2012). The main cultivars for orange juice manufacturing in Brazil include: Hímen, Para, Natal, and Valencia. On the other hand, commercial orange juice manufactures use Valencia or Ponceapple sweet cultivars depending on the season (Tropicana.com). Navel cultivars may be mixed into orange juice mixtures to produce the desired color and flavor (Johnson, 2001). The goal of this study was to see if there may be an effect of pasteurization and concentration on hesperetin and naringenin content in 100% juice made from sweet oranges (Citrus sinensis L.). Various orange juice production processes are shown in Figure 3 including the three products that are the focus of this research: non-pasteurized-not-from-concentrate orange juice (NP-NFC) or domestically-squeezed juice, pasteurized-not-from-concentrate (P-NFC), and pasteurized-made-from-concentrate (P-MFC). Knowing the process that conserves most of the flavanones in orange juice is valuable. Flavanones may be cardio and osteo protective in available foods and beverages.

METHODS
1. Literature search: a literature search on the effect of pasteurization and concentration on the flavanone content in 100% orange juice (Citrus sinensis L.) was carried out.

2. Data collection and selection criteria: analytical techniques for hesperetin and naringenin concentrations in 100% sweet orange juice (Citrus sinensis L.) were retrieved. Summary statistics for hesperetin and naringenin content in each orange juice treatment are in Table 2 and Table 3.

RESULTS
Twenty-two studies from the U.S., EU, and Brazil where researchers analyzed flavanones in 100% orange juice (Citrus sinensis L.) were retrieved. Summary statistics for hesperetin and naringenin content in each orange juice treatment are in Table 2 and Table 3.

CONCLUSION
An understanding the process that conserves most of the flavanones in orange juice is valuable. Flavanones may be cardio and osteo protective in humans, so these orange juice processing techniques have implications when determining appropriate dietary sources of these compounds in available foods and beverages.

REFERENCES