

Studies on by-products from some vegetables

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This investigation included a study on the utilization of some vegetable crops wastes. The raw materials used were: watermelon, carrot haulm, cauliflower leaves and artichoke bracts. The objectives of these studies included the following items: -A) The chemical composition of raw materials. B) Preparing leaf protein concentrate (LPC). C) Production of single cell protein (SCP) by fungal growth (*Aspergillus niger*) and yeast growth (*Saccharomyces cerevisiae*) from different substrates. D) Production of pectin. The obtained results could be summarized as follows: -A) The chemical composition of raw materials indicated that: 1- Watermelon juice contained higher percentage of total sugars (76.18%, on dry weight basis). 2- Carrot haulm and cauliflower leaves contained higher percentage of crude protein (21.28 and 19.36%; on dry weight basis, respectively). 3- Watermelon peels and artichoke bracts contained a good percentage of pectin (10.13 and 6.54%, respectively, on dry weight basis). 4- The protein content was 24.13 and 26.67%, on dry weight basis in juices of carrot haulm and of cauliflower leaves, respectively. It was higher in the juices than in their cakes. 5- Albumins were the first major protein for juice and dehydrated carrot haulm and cauliflower leaves [(47.82 & 47.04) and (49.69 & 41.96) for protein content, respectively], while the globulins were the second major protein [(19.06 & 18.90%) and (17.98 & 13.87%) for protein, respectively]. According to the chemical composition of tested vegetable wastes, carrot haulm and cauliflower leaves were chosen for preparing leaf protein concentrates (LPC), while watermelon peels and artichoke bracts were used for pectin extraction. The watermelon juice, supernatant carrot haulm, supernatant cauliflower leaves, hydrolyzed cake of both carrot haulm and cauliflower to produce single cell protein (SCP). B) Production of leaf protein concentrates (LPC): 1- Different methods based on precipitation or extraction of existent proteins of carrot haulm and cauliflower leaves were evaluated from the point of their efficiency and the characteristics of the resultant LPC. Methods based on precipitating protein from the expressed juices of carrot haulm and cauliflower leaves included various techniques such as different heat (53° & BDOC) (RP- & UNF-), polyanion flocculants (FP-) and acid precipitation (AP-). Methods based on extraction of protein from the chopped materials of carrot haulm and cauliflower leaves included extraction with NaOH (EM-NaOH) and NaCl (EM-NaCl) solutions. 2- Both precipitation and extraction methods resulted in comparable protein recovery data and differences among each method under these two general methods were observed. For example, in case of carrot haulm LPC, maximum total yield (CRL-CYT) was attained using alkali (EM-NaOH) method (81.20% for EM-NaOH vs. 73.50 and 70.091 for MF- and HP- methods, respectively). In case of cauliflower leaves LPC maximum total yield was attained also using alkali method (84.09% for EM-NaOH vs. 78.98 and 69.89 for UNF- and HP- methods respectively. 3- Chemical composition of LPC The chemical composition, of all LPC, prepared by different methods from carrot haulm and cauliflower leaves, was respectively, as follows: Moisture content ranged from 6.63 to 12.0%. The highest moisture content was for CHL-LPC-FP of carrot haulm, while the lowest moisture content was for CYT-LPC-FP cauliflower leaves. Protein content ranged from 36.15 to 53.65% and from 34.53 to 67.28%, on dry basis. Ether extract content ranged from 3.85 to 8.12 and from 1.62 to 8.93%, on dry basis. Ash content ranged from 7.66 to 22.05% and from 6.37 to 21.18%, on dry basis. Crude fiber content for ranged from 2.08 to 8.28% and from 1.56 to 7.62%, on dry basis. Total sugars content ranged from 1.01 to 9.10% and from 3.16 to 15.98%, on dry basis. 4- Characteristics of ~: - CHL-LPC characterized by lower total protein content and total sugar, and higher ash, ether extract and crude fiber contents than the

corresponding CYT-LPG.- Proteins of all CHL- and CYT-LPC of the two sources differed with respect to their solubilities at different pH values. However, CYT-LPC seemed to be more soluble than the CHL-LPC regardless of the source of LPC.- UNF-, CHL-LPC-HP and CYT-LPC-HP exhibited the lowest solubilities at pH values 2-10 especially at pH 2 and above 7, where all other LPC showed superior solubilities (of above 50%). However, LPC-HP had solubilities of not less than 19.71% at pH 10 regardless of LPC source.- Protein classes of LPC, in general, (regardless of the source), UNF- and CHL-LPC proteins were characterized by having albumins as the first major protein and having higher portion of insoluble fraction to the corresponding CYT-LPC. On the other hand, CYT-LPC proteins were characterized by having, glutelins as the first major protein, and albumins as the second and also by having low portion of insoluble protein fraction.- The ion-exchange chromatographic analysis revealed the presence of 16 proteinaceous amino acids in LPC of both carrot haulm and cauliflower leaves.- Acidic amino acids constituted high portion of protein in all the tested LPC where they ranged from 26.13 to 29.21 and from 17.85 to 23.08 g/16 g N in LPC of carrot haulm and cauliflower leaves, respectively. The neutral amino acids comprised the second major part of the total amino acids.- CYT-LPC had the highest content in methionine than CHL-LPC (2.32 and 1.34 g/16 g N) in CYT-LPC of carrot haulm and cauliflower leaves, respectively.- The amino acid pattern of many of the tested LPC was competitive with many good quality animal proteins such as meat protein having a good level of the essential amino acids compared with the FAO reference pattern.- The obtained LPC varied greatly, from the point of mineral availability. Mineral elements varied in LPC according to the source and method of extraction.- It seems that consumption as small as about less than 100 g of each carrot haulm and cauliflower leaves LPC preparations would satisfy the daily recommended allowance and in turn, requirements of Mg, Ca, Cu, Zn and Fe.

C) Side cell protein (SCP) production: Production of SCP by using fungal growth (*Aspergillus niger*) and yeast growth (*Saccharomyces cerevisiae*) on: watermelon juice, supernatant carrot haulm, supernatant cauliflower leaves, hydrolyzed cake of carrot haulm and cauliflower leaves.

- 1- Increasing the incubation period increased the consumed sugar and total yield for different substrates by using fungi and yeast.
- 2- The protein content and case of using watermelon other substrates, where the protein yield were higher in juice as a medium, than by the use of fungi or by yeast.
- 3- Yield coefficient percentage was higher in case of using fungi than using yeast for all substrates, while protein yield was higher in case of using yeast than using fungi.
- 4- Moisture, crude protein and ash contents were lower while ether extract higher in SCP yielded by fungi than that yielded by yeast.
- 5- Amino acids content was higher in SCP produced by fungi (88.74 g/16 g N) than in that produced by yeast (72.51 g/16 g N).
- 6- The first limiting amino acid for SCP yielded by using both fungi and yeast was methionine. The second limiting for SCP produced by fungi was threonine and valine in SCP produced by yeast.
- 7- Nucleic acid content was higher in SCP yielded by yeast while it was (16.28-18.05 g/100 g protein) than in that yielded by fungi (1.98-2.28 g/100 g protein).
- 8- Mineral content of SCP yielded by fungi was higher in Mg, P, [and Zn, while the SCP yielded by yeast was higher in Ca, Na, Fe, Mn and Cu.

D) Pectin production:

- 1- Total pectin content in watermelon peels was higher than in the artichoke bracts (11.47 and 7.83%, on dry basis, respectively).
- 2- Pectin soluble in ammonium oxalate was the major part of pectin in both artichoke bracts and watermelon peels (51.85 and 55.01%, respectively).
- 3- The yield of pectin increased with increasing ammonium oxalate concentration and also, with increasing temperature for both artichoke bracts and watermelon peels.
- 4- The pectin extracted from watermelon peels was higher in ash, acetyl, reducing power and AGA (anhydrous galactourinic acid) contents, while was lower in the methoxyl as compared with commercial pectin.

S- Physical properties of pectin extracted from watermelon was nearly similar to properties of commercial pectin.