CITRUS WASTES AS A SOURCE OF FUNCTIONAL INGREDIENTS IN MEAT PRODUCTS

By

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B.Sc. Agric. Sci. (Food Technology), Cairo University, 2011

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ABSTRACT

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Citrus fruit peel by-products can be promising source of functional compounds and dietary fiber. Lemon and orange peels (LP and OP) considered the primary citrus by-products and discarded as wastes. Re-using these wastes in a suitable form may be of considerable economic benefit to food processors.

The aim of this work was to study the potential use of orange and lemon peels as natural sources of functional ingredients e.g phenolic compounds and dietary fiber in meat products. Physico-chemical and functional properties as well as phenolic acids profiles of raw and dried peels were evaluated. Ethanolic and methanolic extracts of the fresh and dried peels (using microwave or air oven drying methods) were used to evaluate their phytochemical contents, antioxidant and antimicrobial activities. Proximate chemical composition, vitamin C, phenolic, flavonoids contents, also radical scavenging activities (DPPH), Trolox equivalent antiradical capacity (TEAC) and β-carotene assays, as well ferric reducing antioxidant power (FRAP) and Hydroxyl radical (OH^+) scavenging activity were determined.

In order to improve the functional value of meat product, application of these citrus peels at the levels 1 and 2% in the suggested ground beef meat patties formulae were carried out. Quality and shelf-life properties of beef patties as affected by adding citrus peels during refrigeration at 4°C for 15 days and freezing at -20°C for 30 days storage were studied.

Regarding to the results of physico-chemical analyses, it was noticed that fresh LP had higher %s of moisture, protein, ether extract, fiber and ash than OP. After drying, lemon peels still have had more crude protein, total fiber and ash contents except ether extract compared to

orange peel. The ash and fiber contents of lemon peels had significantly more %s compared to orange peels treated by microwave or air oven drying methods. Color investigation showed high lightness value for dried orange and lemon peels by air oven, high values of redness and yellowness color parameters were realized for microwave dried orange and lemon peels compared to control. Dried OPs by air oven had the highest water and oil holding capacities. However dried lemon peels by the same device were noticed to be higher in water holding capacity than control sample. Total dietary fiber content in fresh orange peel was of less % than lemon peels. Dried LPs by microwave and air oven was higher in total dietary fiber than that in orange peels. Fresh LPs contain more insoluble dietary fiber than OPs. After drying by the two mentioned methods, microwave dried lemon and orange peels still have more insoluble dietary fiber than that of air oven dried ones. Furthermore fresh and dried orange peel samples contain more soluble dietary fiber than the lemon peels.

The results of antioxidants analysis (phenols) and antioxidant activity conducted on successive extracts showed that the microwave drying did significantly affect these parameters in orange or lemon peels either methanolic or ethanolic extracts. An opposite pattern was noticed i.e. methanolic or ethanolic extracts of dried orange and lemon peels by air oven contained more flavonoids than microwave drying. The HPLC results revealed that naringin and hisperdin were the predominant phenolic acids in all tested samples with different concentrations.

Ethanolic extract of dried lemon peels by microwave inhibited *S. aureus*, *L. monocytogenes*, *B. subtilis*, *P. aeuroginosa*, *S. typhi*, and *E. coli* bacteria compared to methanolic extract except *Aspergillus flavus* and *C. albicans* which showed no susceptibility to this extracts compared to ampicillin, antifungal agent amphotericin B and control. The methanolic extract of dried lemon peels with air oven showed low antimicrobial activity which inhibited only four bacteria, while the ethanolic extract was

more effective than that of methanolic extract in inhibition of six bacteria strains. Dried orange peel by microwave and extracted with ethanol inhibited *B. subtilis, E. coli, P. aeuroginosa, L. monocytogenes* and *C. albicans* compared to methanolic extract which inhibited *B. subtilis, E. coli, P. aeuroginosa,* and *C.albicans*.

Addition of 1 or 2% OP and LP to beef patties caused a reduction in moisture, thiobarbituric acid reactive substances, total volatile basic nitrogen,microbial count. Changes of pH value, shrinkage % and thawing values, somewhat increase in fat, ash, protein %s, cooking yield, moisture retention, fat retention, water and oil holding capacity were noticed. In addition the levels of OP or LP (1 or 2%) affected the color, radical scavenging activity, texture and sensory properties relative to control.

Key words: Citrus by-products/waste, Lemon peels, Orange peels, Physico-Chemical compositions, Antioxidant properties, Phenolic compounds, Beef patties, Antimicrobial activity.

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CONTENTS

LIST OF TABLES