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Entitled

STUDY OF IN-VITRO BIOACCESSIBILITY AND IN-VIVO BIOAVAILABILITY OF KHALAS VARIETY  
DATE SEED POLYPHENOLS FOR FUNCTIONAL APPLICATION IN THE HUMAN DIET

by

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Abstract

Date seeds are a rich source of polyphenols and represent an ideal candidate as a functional ingredient for the food industry. This doctoral work investigated Khalas variety date seeds in three forms, date seed powder (DSP), date seed ethanolic extract (DSE) and functional food developed with the seeds; date seed pita bread (DSB). The study characterised the polyphenol profile by mass spectrometry and investigated its bioaccessibility using simulated in-vitro digestion coupled with Caco-2 model for absorption and transport. It further explored the bioavailability of date seed polyphenols in-vivo in humans by conducting a cross-over study in 16 healthy volunteers. The crossover study examined the urinary excretion of polyphenols and its metabolites, and it investigated the antioxidant effect after consumption of six doses of date seed samples (0.25g and 0.5g/kg body weight DSP, 360g of 10% and 15% DSB, 30mg and 60mg/kg body weight DSE). The presence of phenolic acids, flavanols, flavonols and flavones were observed in the date seed samples. Flavan-3-ols was the most significant group present which was predominantly polymeric proanthocyanidins. Phenolic acids such as protocatechuic acid, vanillic acid and caffeoylshikimic acid were recovered from DSP and DSE following in-vitro digestion while the recovery was significantly lower DSB. Similarly, compounds such as protocatechuic acid, p-hydroxybenzoic acid, caffeoylshikimic acid, p-coumaric acid, syringic acid hexoside and diosmin were transported from digested DSP and DSE. However, only protocatechuic acid and p-hydroxybenzoic acid transported from DSB. In the in-vivo study, an abundant release of polyphenols was detected in urine within 3 hours, reached a peak at 8 hours then decreased, with polyphenol metabolites still being detected, up to 24 hours. Biomarker of antioxidant status, glutathione, was strengthened from 1 hour and up to 8 hours post intake. Biomarkers of protein and lipid oxidative damages were reduced from 1 hour and up to 8 and 24 hours post intake, respectively. The present work validates date seeds as a useful polyphenol source by demonstrating the bioaccessibility of its polyphenols from digested samples and their subsequent absorption and transport. The study also provides the first report on polyphenol metabolites and improved antioxidant status with the consumption of date seed product in humans.

**Keywords:** Nutrition, functional food, date seeds, polyphenols, bioaccessibility, bioavailability.