

Sustainable Chemistry and Pharmacy

Valorisation of waste chicken feathers: Optimisation of decontamination and pre-treatment with bleaching agents using response surface methodology

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Abstract

Environmental concerns, rapid oil consumption, the high price of oil, and limited oil reserves are driving research into cheap, biodegradable, sustainable, renewable, and abundantly available green materials. Waste chicken feathers are abundant and cheap by-products from poultry processing plants and their beneficiation offers possible solutions to these issues. Raw chicken feathers are wastes that are mixed with offal fat, debris, blood, preen oil and other wastes from the poultry process. Consequently, feathers are hazardous wastes that are contaminated with bacteria, which makes them odoriferous and unfit for valorisation as is. These contaminants must be removed before possible valorisation otherwise the feathers will not fit for purpose. The effects of oxidative (hydrogen peroxide and sodium hypochlorite) and reductive (Sodium dithionite) compounds as decontamination agents were studied on chicken feathers to assess their decontamination and pre-treatment efficiency and their effects on physicochemical and mechanical properties of the feathers. Statistically designed experiments were used to optimise the decontamination process using response surface methodology with a Box-Behnken experimental design. Regression equations were obtained to analyse microbial count and the optimum process parameters were identified. Under optimised conditions, the treated chicken feathers were characterised and their properties compared with those of unwashed chicken feathers. From the results, it was deduced that the inorganic bleaching treatments were effective removing the microbial impurities from the feathers and their use resulted in enhanced physicochemical properties of the chicken feathers. The untreated chicken feathers had the highest microbial counts ($1.48E+07 \pm 6.72E05$ Cfu/g) whereas decontaminated samples showed a reduction in thousand-fold. The impurity removal after washing was about 8–18%.