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Comparative study of recycled papers to be used as an alternative for food packaging: quality assessment and heavy metal migration testing

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The permanence and durability of recycled papers are important as virgin papers are chosen for the definitive end-use. The main objective of this study was to assess the paper quality of recycled papers used as an alternative for food packaging. Three types of recycled papers, Brown Kraft papers (R1), Yellow Kraft papers (R2), and White papers (R3), were collected. Physical parameters; grammage, thickness, burst strength, tensile strength, water absorptiveness, chemical parameters; pH and optical parameters; opacity, brightness, and whiteness of the selected papers were tested using standard methods. At first, sample papers were subjected to accelerated ageing by keeping them in a closed ageing chamber at 50 % relative humidity and 90°C (ASTM D4714 method). Samples were tested after accelerated ageing of 3 days, 7 days, 14 days, 21 days, and 28 days, similar to the natural ageing of 0, 384 days, 2.5 yrs., 3.5 yrs., 4.9 yrs., 7.4 yrs., and 9.8 yrs., respectively. Heavy metal migration test was done to evaluate the suitability of the recycled papers as food packaging material. Five different food types, burgers, pizza, Sausages, candy, and chocolates, were selected, and 500 g of each food type was wrapped with 2 dm² sized recycled papers stated above and kept for 72 hours in normal laboratory conditions. Three replicates were used for each food type. The presence of heavy metals in food samples was extracted using a 3% (v/v) metal-free solution of acetic acid for 24 hours at 40°C. At the end of the treatment, contact liquid was collected and analyzed for heavy metals using atomic absorption spectroscopy (AAS). The presence of heavy metals in food packaging materials was compared with four different food packaging standards. Opacity has increased in all the recycled papers with accelerated ageing. Other parameters showed a decreasing trend over time. All three types of recycled papers failed the water absorptiveness test after accelerated ageing on day 3. Changes in pH varied from alkaline to neutral (pH 9.1 to 7.4) in recycled papers over time. In conclusion, all the recycled papers are not suitable for printing and writing as they fail water absorptiveness. As parameter changes can be observed after accelerated ageing of 21 days in recycled papers, they can be used as archival or artist's paper for 7.4 years without discolouring or deteriorating. The Recycled papers produced in this study can be recommended for food packaging as they show the highest permanence in terms of tensile and burst strength. However, as recycled papers fail the water absorptiveness, it is recommended to use them to pack dry food. The available amounts of heavy metals present Cu, Zn, Mn, and Cr are not exceeded within the EU, EC, EPA, and SLS food packaging standards for recycled papers. Ni was not detected in R1, R2, and R3 recycled papers. However, according to the Council of Europe standard, it exceeds the permissible Pb level in food packaging materials. When considering the migration of heavy metals from recycled papers into food, R1, R2, and R3 recycled papers can be recommended for food packaging as per the EPA, EC, and SLS standards without further treatments. Food items with high levels of fatty acids facilitate the higher migration of heavy metals compared to food items with lower fatty acid levels.

Keywords: Accelerated ageing, Heavy metals, Migration test, Recycled papers.