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Freezing, thawing and cooking effects on quality profile assessment of green beans (cv. *Win*)

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Abstract Results are presented of the effect of freezing followed by thawing (air and water immersion, both at environmental temperature) and cooking (traditional boiling in a covered pot) on quality profile (in terms of objective texture, colour, chlorophylls and pheophytins and sensory attributes) and structure of green beans (cv. *Win*). Freezing was carried out at three different rates by forced convection with liquid nitrogen vapour. Kramer shear cell (KSC) and Warner–Bratzler (WB) tests were used for objective assessment of the texture. The highest parameter values occurred in beans frozen at the highest rate and air-thawed at the slowest rate. Also, minimum alteration of the rheological behaviour of cooked beans was achieved by freezing at the highest rate. The best parameter for assessing the texture of frozen green beans after thawing and cooking was the Warner–Bratzler slope (S_{WB}). Coefficients of softening estimated for S_{WB} in the thawed beans showed that the texture of the beans frozen at -24°C was almost four and almost five times softer than that of the beans frozen at -70°C , for air and water thawing respectively. Frozen and thawed green beans were darker than fresh control, whereas freezing prior to cooking produced lighter-coloured beans than direct cooking. The freezing rate affected colour parameters differently depending on the process that followed. When beans were thawed, increasing the freezing rate produced

lighter-coloured beans, whereas when beans were cooked, increasing the rate produced darker-coloured beans. No difference was found in sensory assessments between cooked samples frozen at -24°C , -35°C and -70°C , which probably reflects the panellists' mixed preferences for quickly and slowly frozen samples. Scanning electron microscopy (SEM) revealed different degrees of mechanical damage to tissue structure, which accounted for the rheological behaviour of the beans.

Keywords *Phaseolus vulgaris* L. · Freezing and thawing rates · Cooking · Mechanical tests · Quality profile · Sensory analysis · Structure

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