SUMMARY

The effect of caffeine on the permeability of plant cell membranes was investigated using beet root discs (*Beta vulgaris* L.) potato tuber discs (*Solanum tuberosum* L.), pea (*pisum sativum*) and corn (*Zea mays*) stem segments.

1. Discs of beet root and potato tuber exhibited an increased efflux of betacyanin, carbohydrates and aminoacids on treatment with caffeine.

2. In the case of pea and corn stem segments, the index of damage due to caffeine treatment was the release of intracellular contents (mainly 260 nm and 280 nm absorbing substances). The release was found proportional to the concentration of caffeine in the range tested and obeyed Michaelis-Menten kinetics with respect to caffeine concentration.

3. Compared to pea, corn tissue was more sensitive to caffeine.

4. Time-course incubation studies indicate that the release followed a biphasic pattern having an exponential response up to 45 minutes and then plateaued off.

5. Caffeine-induced permeability change was dependent on the pH of the medium during treatment.

6. An analysis of the effluent material indicated that a major portion of the released substances were small
molecules and dialyzable.

7. Amino acids, carbohydrates and Pi also leaked out considerably after caffeine treatment.

8. Addition of Ca\(^{2+}\) reduced the degree of caffeine-induced permeability, suggesting that the leakage of cell contents might be due to alteration in membrane structure.

9. The decrease of caffeine-induced permeability by Ca\(^{2+}\) ions seems to be non-competitive type.

10. The other bivalent cations Mg, Mn, Co, Fe, Ni, Zn, & Cu reversed partially the permeability change induced by caffeine. The protective effect was in the order: Mn Mg Ca Co Fe Ni Zn. The monovalent cations, K\(^+\) and Na also showed protective effect.

11. A combination of caffeine and EDTA or EGTA caused greater permeability compared to caffeine alone and this effect was reversed by calcium ions.

12. Spermine interfered in the action of caffeine on plant cell membranes, this interference resembles the action of metal ions.

13. SDS had poor effect on cell membrane; in combination with caffeine, it showed protective effect.
14. Local anesthetics procaine and lidocaine did not have a significant effect whereas chlorpromazine inflicted damage on membranes when applied alone and in combination with caffeine, partially reversed the effects of caffeine in a manner similar to Ca$^{2+}$.

15. Caffeine effected an increase in the uptake of precursors of nucleic acids and protein at lower concentrations and at higher concentrations inhibited the uptake.

16. The effect of cyclic adenosine 3', 5'-monophosphate and dibutyryl cAMP on the permeability were not significant.

17. Methyl xanthines aminophylline and theophylline altered the permeability similar to caffeine. The results are discussed in terms of the mechanism of action of caffeine.