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Pesticide Exposure and Human Health: Risk Assessment Through Dietary Intake Analysis

Chada Anu Reddy*
Ph.D. Scholar, Department of Entomology, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University (Imphal), Umiam- 793103, Meghalaya, India.

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Abstract

The excessive use of pesticides in agriculture poses serious dangers to human health, both directly and indirectly, and may even cause cancer. Depending on the length of exposure and certain chemical features, pesticide toxicity, persistence, and accumulation in the body can result in major health issues, most notably impairment to the reproductive system. In this study, dietary risks are evaluated using the hazard quotient (HQ), which measures risk levels in rural as well as urban populations depending on food consumption patterns by comparing estimated daily intake (EDI) to acceptable daily intake (ADI). The calculation of the theoretical maximum dietary intake (TMDI) and maximum permissible intake (MPI) is necessary to determine safety. Pesticides are categorized to be harmless if the TMDI falls lower than the MPI. To compute overall risk for several residues, the Hazard Index (HI) is performed.

Introduction

Overuse of pesticides in agriculture poses both direct and indirect risks to human health, as their chemical components can disrupt biological processes, potentially leading to diseases like cancer. Pesticides are known for their toxicity, ability to accumulate in the body, and persistence, all of which contribute to adverse health effects. Eating food contaminated with pesticides may cause serious health complications, including reproductive harm. The risks associated with pesticide exposure depend on factors such as exposure duration and the specific toxic properties of the chemical used.

Dietary risk is often assessed using the hazard quotient (HQ). The estimated daily intake (EDI) is computed at the pre-harvest interval and expressed as mg per kg of body weight per day. Food consumption data is sourced from the NSSO (2014). HQ is derived by dividing EDI by the acceptable daily intake (ADI). This assessment helps to determine risk levels in both

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rural and urban populations, considering their both food consumption patterns. An HQ greater than 1 indicates elevated risk (Katna et al., 2018).

$$EDI = \frac{\text{Residue } (mg\ kg^{-1}) \text{ x Food consumption } (kg\ day^{-1})}{\text{Body weight (kg)}}$$

$$HQ = \frac{\text{Estimated daily intake}}{\text{Acceptable daily intake}}$$

Based on MRLs and daily food consumption, the theoretical maximum dietary intake (TMDI) is computed to assess total exposure. The maximum permitted intake (MPI), which is determined by multiplying the ADI by the average human weight (60 kg, ICMR 2010), is then compared to the TMDI. According to Katna et al., 2018, a pesticide is considered safe if its TMDI value is lower than its MPI and MRL values.

$$MPI = Acceptable\ daily\ intake\ x\ Average\ body\ weight$$

$$TMDI = MRL\ x\ Per\ capita\ consumption$$

When MRLs for any pesticide are unavailable particularly for a vegetable, the parameter theoretical maximum residue contribution (TMRC) is utilized for the safety evaluation. To know if that pesticide is harmful, the values of TMRC and MPI are compared in a same manner as mentioned above (Rahman et al., 2017)

$$TMRC = Residue\ in\ ppm\ x\ Daily\ Consumption\ of\ food\ commodity$$

The overall risk for different pesticide residues on a single commodity is computed using the parameter Hazard Index (HI), which is the add up of the HQs for every chemical on that particular commodity. Any food item is regarded as potentially hazardous if its HI value is more than 1 (Galani et al., 2020).

$$HI = \sum_{i=0}^{n} HQi$$

Different researchers used different terms to indicate the same parameter, HQ as RQ (Risk Quotient) (Singh et al., 2023), HRI (Health Risk Index) (Alam et al., 2015, Fatunsin et al., 2020) which are computed by the same formulae with that of HQ and also evaluated similar to it (HRI or RQ exceeds 1, there may be significant health concerns).

Conclusion

To sum up, the overuse of pesticides in agriculture poses significant risks to human health, emphasising the significance of regularly monitoring pesticide levels in food. This study highlights the critical need of assessing dietary risks using metrics such as the maximum

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permissible intake (MPI), theoretical maximum dietary intake (TMDI), and hazard quotient (HQ) to ensure food safety. Regulatory bodies and public health authorities should always have any eye on reducing dangers, bringing up strong laws and improving farming practices and so on.

Reference

Alam, M. N., Chowdhury, M. A. Z., Hossain, M. S., Mijanur Rahman, M., Rahman, M. A., Gan, S. H. and Khalil, M. I. (2015). Detection of residual levels and associated health risk of seven pesticides in fresh eggplant and tomato samples from Narayanganj District, Bangladesh. *Journal of Chemistry*, (1): 1-7. http://dx.doi.org/10.1155/2015/243574

Fatunsin, O. T., Oyeyiola, A. O., Moshood, M. O., Akanbi, L. M., and Fadahunsi, D. E. (2020). Dietary risk assessment of organophosphate and carbamate pesticide residues in commonly eaten food crops. *Scientific African*. 8: 1-10. https://doi.org/10.1016/j.sciaf.2020.e00442

Galani, Y. J. H., Houbraken, M., Wumbei, A., Djeugap, J. F., Fotio, D., Gong, Y. Y., and Spanoghe, P. (2020). Monitoring and dietary risk assessment of 81 pesticide residues in 11 local agricultural products from the 3 largest cities of Cameroon. *Food Control*, 118: 107416. https://doi.org/10.1016/j.foodcont.2020.107416

Katna, S., Dubey, J. K., Patyal, S. K., Devi, N., Chauhan, A., and Sharma, A. (2018). Residue dynamics and risk assessment of Luna Experience® (fluopyram+ tebuconazole) and chlorpyrifos on French beans (Phaseolus vulgaris L.). *Environmental Science and Pollution Research*, 25: 27594-27605. https://doi.org/10.1007/s11356-018-2733-4

Rahman, H., Mishu, M. H., Swapon, A. H., Hossain, M. M., and Akter, T. (2017). Degradation pattern and risk assessment of imidacloprid in country bean using gas chromatography. *Annals of Bangladesh Agriculture.* 21 (1 & 2): 13-25.

Singh, S., Saini, L. K., Solanki, V. H., Kansara, R. V., Gandhi, K. D., and Patel, N. (2023). Dissipation kinetics and health risk assessment of certain insecticides applied in/on tomato under open field and poly-house conditions. *Heliyon.* 9: 1-9. https://doi.org/10.1016/j.heliyon.2023.e14963