

ABSTRACT

There are problems with the quality of education and the cognitive growth of Indonesian students, as seen by their declining PISA scores. Neuroplasticity, facilitated by the TrkB receptor and the Brain-Derived Neurotrophic Factor (BDNF) pathway, is essential for cognition. It is not yet known how dietary polyphenols interact with TrkB or how they relate to the diets of young children, despite the fact that they may have neuroprotective effects. Aiming to trace real intake among TPQ Margo Hasanah students and evaluate polyphenols as neural modulators via in silico analysis against TrkB is the objective of this study. First, we utilized molecular docking to screen 324 polyphenols from Phenol-Explorer against TrkB. Second, we surveyed 74 students using the Qualitative Food Frequency Questionnaire (Q-FFQ). This two-stage approach allowed us to capture all relevant data. A total of 176 compounds with a high affinity (score < -8 kcal/mol) were found through the in silico analysis. Predicted as direct orthosteric agonists were Anthocyanins (e.g., Pelargonidin) and Flavanones (e.g., Neohesperidin), while Flavones were seen as potential allosteric modulators at the transmembrane location, resembling antidepressant processes. Regular consumption of various foods rich in polyphenols, such as shallots, tempeh, tofu, and oranges, was found through qualitative food frequency questionnaires. Activation of TrkB signaling through dual pathways (agonist and potentiator) is expected to promote cognitive function, as are foods high in polyphenols found locally.

Keywords: In Silico, Polyphenols, TrkB Receptor, Neuroplasticity, Local Food, Free Nutritious Meal (MBG).

INTISARI

Penurunan skor PISA di Indonesia mengindikasikan tantangan serius dalam kualitas pendidikan dan perkembangan kognitif pelajar. Kemampuan kognitif bergantung pada neuroplastisitas yang dimediasi oleh jalur *Brain-Derived Neurotrophic Factor* (BDNF) dan reseptor *Tropomyosin Receptor Kinase B* (TrkB). Polifenol pangan berpotensi mendukung neuroproteksi, namun interaksi spesifiknya dengan TrkB serta relevansinya pada pola konsumsi anak usia dini masih kurang dipahami. Penelitian ini bertujuan mengevaluasi potensi polifenol sebagai modulator perkembangan neuron melalui analisis *in silico* terhadap reseptor TrkB dan memetakan asupan polifenol aktual pada santri TPQ Margo Hasanah. Studi ini menggunakan pendekatan dua tahap: (1) *Molecular docking* menyaring 324 polifenol dari *Phenol-Explorer* terhadap TrkB, dan (2) Survei *Qualitative Food Frequency Questionnaire* (Q-FFQ) pada 74 santri. Hasil *in silico* mengidentifikasi 176 senyawa afinitas tinggi (skor ≤ -8 kcal/mol). *Antosianin* (seperti *Pelargonidin*) dan *Flavanone* (seperti *Neohesperidin*) diprediksi sebagai agonis langsung pada situs ortosterik, sementara *Flavone* menunjukkan potensi sebagai modulator alosterik pada situs transmembran, mirip mekanisme antidepresan. Metode Q-FFQ menunjukkan santri rutin mengonsumsi sumber polifenol tersebut, terutama bawang, tempe, tahu, dan jeruk. Pangan lokal kaya polifenol diprediksi kuat mengaktifkan jalur TrkB melalui mekanisme ganda (agonis dan potensiator), mendukung fungsi kognitif.

Kata Kunci: *In Silico*, Polifenol, Reseptor TrkB, Neuroplastisitas, Pangan Lokal, Makan Bergizi Gratis (MBG).