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Blueberry benefits to cognitive function across the lifespan

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ABSTRACT

It is well known that what we eat can influence our physical wellbeing, but interest is also increasing in the relationship between our diet and cognitive health. In recent years, blueberries have risen from relative obscurity to superfood status following a number of published epidemiological studies, rodent trials, and human RCTs, that suggest blueberries may convey benefits to cognition and mood. This commentary explores some of the evidence in humans, particularly during periods of cognitive development in the young and cognitive decline in the elderly. Evidence for possible mechanisms of action are also described. There is little doubt that blueberries convey a small, but tangible, benefit to cognitive function. Effects are seen following dose sizes easily achievable within a normal diet. Nevertheless, further research is needed on the cognitive domains influenced, additional benefits of longer-term supplementation, mechanisms of action responsible, and the real-world relevance of the cognitive benefits attained.

KEYWORDS

Blueberries; Anthocyanins; Cognition; Mood; Development; Ageing

INTRODUCTION

The field of Nutritional Psychology has grown rapidly in recent years. It has long been known that what we eat can influence our physical wellbeing, but increasing interest has been shown in the relationship between our diet and cognitive function. Blueberries are a notable success story within the field, having risen from relative obscurity to popular superfood in only a few decades. Blueberries provide a rich source of polyphenols, including anthocyanins, which research has linked with a multitude of physical and cognitive benefits.

Extracts, powders, juices and concentrates are now found in high street health food stores, and fresh berries are available in supermarkets. This commentary gives an overview of some of the evidence that elevated the blueberry to its current status as a superfood beneficial for cognitive function across the lifespan, particularly at key times throughout development and ageing.

BLUEBERRY BENEFITS IN CHILDREN AND YOUNG ADULTS

The childhood benefits of blueberries have only recently become the focus of research. Interest in the quality of children's diet has increased due to a rise in rates of childhood obesity. This ongoing Western concern has been shown to impact not just physical but also cognitive development. Early educational attainment in children is of paramount importance and so a number of blueberry studies have focussed on primary school aged children. Single doses of blueberry have been shown to improve memory (Whyte & Williams 2015; Whyte, Schafer, & Williams 2016), and executive function (Whyte, Schafer, & Williams 2017) in this young age group, showing the importance of good nutrition throughout the school day. Research has also begun to extend cognitive testing in this age group to include classroom relevant measures such as reading tasks (Barfoot et al. 2018). However, further research is needed to determine the full educational potential of long-term blueberry interventions, particularly in the area of special educational needs.

The current academic and social pressures on children and young adults have also raised recent concerns over mental health. Anxiety and depression are becoming increasingly prevalent in children and adolescents, and blueberries may also play a beneficial role here, as the executive function benefits of blueberries reported in children may also extend to cognitive control of mood. Indeed, improved positive affect has been observed in children and young adults following a single dose of freeze-dried blueberries (Khalid et al. 2017).

Research investigating the long-term benefits of blueberries on mood is ongoing and we await the results with interest.

BLUEBERRY BENEFITS IN AGEING

Blueberries have been observed to be particularly beneficial as we age. Indeed, this has been the primary focus of much Nutritional Psychology research, as Governments seek dietary intervention strategies to help reduce mounting healthcare bills for a global ageing population. Epidemiologically, consumption of blueberries has been associated with slower rates of cognitive decline during the ageing process (Devore et al. 2012). Experimentally, daily supplementation with blueberry interventions has resulted in enhanced neural activity and improved working memory performance (Bowtell et al. 2017), and improved memory and executive function performance (Miller at al. 2018; Whyte et al. 2018), in older adults. These effects are not limited to healthy ageing. Blueberries have also shown promise in age-related neuropathology. For example, daily blueberry supplementation enhanced memory performance (Krikorian et al. 2010), and neural activity during a working memory exercise (Boespflug et al. 2018), in older adults previously diagnosed with mild cognitive impairment. Long term human studies investigating the impact of blueberries on the progression of Alzheimer's and Vascular Dementia are yet to emerge. Ethical considerations preclude the investigation of blueberry effects on pathology in isolation; however, blueberry interventions may be useful alongside conventional treatments.

MECHANISMS OF ACTION

Mechanisms of action require ongoing investigation, but it is likely that blueberries exert their benefits via multiple pathways, including antioxidant effects (Kay & Holub 2002), vascular effects (Rodriguez-Mateos et al. 2013), glucoregulation (Bell et al. 2017),

neurosynthesis (Miller & Shukitt-Hale 2012), and gut microbiota interactions (Williamson & Clifford 2010). Different mechanisms may have greater or lesser relevance across the lifespan. For example, antioxidant effects are likely to be of minimal benefit during early development, but may be more important during our middle and older years. Researchers are tasked with unravelling the different cognitive benefits of blueberries and their associated mechanisms as they alter throughout life.

CONCLUSION

Mechanisms aside, what is clear from the research to-date is that cognitive benefits of blueberries are tangible, observable effects arising from small to moderate quantities of blueberries. Systematic reviews have revealed positive effects for extracts, juices, and whole berries (usually freeze-dried and powdered) at doses equivalent to 1 cup of fresh blueberries or less (Travica et al. 2019; Hein et al. 2019). Such quantities are easily achievable within a normal diet, and it is likely that we would all benefit from consuming them regularly, while awaiting further research on the precise cognitive domains influenced, additional benefits of longer-term supplementation, detailed mechanisms of action responsible, and the real-world relevance of the cognitive benefits attained.

DISCLOSURE STATEMENT

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References:

Barfoot, K.L., May, G., Lamport, D.J., Ricketts, J., Riddell, P.M. and Williams, C.M., 2018. The effects of acute wild blueberry supplementation on the cognition of 7–10-year-old schoolchildren. *European journal of nutrition*, pp.1-10.

Bell, L., Lamport, D.J., Butler, L.T. and Williams, C.M., 2017. A study of glycaemic effects following acute anthocyanin-rich blueberry supplementation in healthy young adults. *Food & function*, *8*(9), pp.3104-3110.

Boespflug, E.L., Eliassen, J.C., Dudley, J.A., Shidler, M.D., Kalt, W., Summer, S.S., Stein, A.L., Stover, A.N. and Krikorian, R., 2018. Enhanced neural activation with blueberry supplementation in mild cognitive impairment. *Nutritional neuroscience*, *21*(4), pp.297-305.

Bowtell, J.L., Aboo-Bakkar, Z., Conway, M.E., Adlam, A.L.R. and Fulford, J., 2017. Enhanced task-related brain activation and resting perfusion in healthy older adults after chronic blueberry supplementation. *Applied Physiology, Nutrition, and Metabolism*, *42*(7), pp.773-779.

Devore, E.E., Kang, J.H., Breteler, M.M. and Grodstein, F., 2012. Dietary intakes of berries and flavonoids in relation to cognitive decline. *Annals of neurology*, *72*(1), pp.135-143.

Hein, S., Whyte, A.R., Wood, E., Rodriguez-Mateos, A. and Williams, C.M., 2019. Systematic review of the effects of blueberry on cognitive performance as we age. *The Journals of Gerontology: Series A*, *74*(7), pp.984-995.

Kay, C.D. and Holub, B.J., 2002. The effect of wild blueberry (Vaccinium angustifolium) consumption on postprandial serum antioxidant status in human subjects. *British Journal of Nutrition*, *88*(4), pp.389-397.

Khalid, S., Barfoot, K., May, G., Lamport, D., Reynolds, S. and Williams, C., 2017. Effects of acute blueberry flavonoids on mood in children and young adults. *Nutrients*, *9*(2), p.158.

Krikorian, R., Shidler, M.D., Nash, T.A., Kalt, W., Vinqvist-Tymchuk, M.R., Shukitt-Hale, B. and Joseph, J.A., 2010. Blueberry supplementation improves memory in older adults. *Journal of agricultural and food chemistry*, *58*(7), pp.3996-4000.

Miller, M.G., Hamilton, D.A., Joseph, J.A. and Shukitt-Hale, B., 2018. Dietary blueberry improves cognition among older adults in a randomized, double-blind, placebo-controlled trial. *European journal of nutrition*, *57*(3), pp.1169-1180.

Miller, M.G. and Shukitt-Hale, B., 2012. Berry fruit enhances beneficial signaling in the brain. *Journal of agricultural and food chemistry*, *60*(23), pp.5709-5715.

Rodriguez-Mateos, A., Rendeiro, C., Bergillos-Meca, T., Tabatabaee, S., George, T.W., Heiss, C. and Spencer, J.P., 2013. Intake and time dependence of blueberry flavonoid–induced improvements in vascular function: a randomized, controlled, double-blind, crossover intervention study with mechanistic insights into biological activity. *The American journal of clinical nutrition*, *98*(5), pp.1179-1191.

Travica, N., D'Cunha, N.M., Naumovski, N., Kent, K., Mellor, D.D., Firth, J., Georgousopoulou, E.N., Dean, O.M., Loughman, A., Jacka, F. and Marx, W., 2019. The effect of blueberry interventions on cognitive performance and mood: a systematic review of randomized controlled trials. *Brain, behavior, and immunity*.

Whyte, A., Cheng, N., Fromentin, E. and Williams, C., 2018. A randomized, double-blinded, placebo-controlled study to compare the safety and efficacy of low dose enhanced wild blueberry powder and wild blueberry extract (ThinkBlue™) in maintenance of episodic and working memory in older adults. *Nutrients*, *10*(6), p.660.

Whyte, A.R., Schafer, G. and Williams, C.M., 2016. Cognitive effects following acute wild blueberry supplementation in 7-to 10-year-old children. *European journal of nutrition*, *55*(6), pp.2151-2162.

Whyte, A.R., Schafer, G. and Williams, C.M., 2017. The effect of cognitive demand on performance of an executive function task following wild blueberry supplementation in 7 to 10 years old children. *Food & function*, *8*(11), pp.4129-4138.

Whyte, A.R. and Williams, C.M., 2015. Effects of a single dose of a flavonoid-rich blueberry drink on memory in 8 to 10 y old children. *Nutrition*, *31*(3), pp.531-534.

Williamson, G. and Clifford, M.N., 2010. Colonic metabolites of berry polyphenols: the missing link to biological activity?. *British Journal of Nutrition*, *104*(S3), pp.S48-S66.