Cognitive functions associated with consumption of traditional volumes of kava (*Piper methysticum*): A feasibility study

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Introduction

It is believed the traditional Pacific drink kava contributes to unsafe driving. A recent study utilising an industry standard measure of drug driving failed to register effects to selected cognitive functions[1].
The following reports on a subsequent feasibility study with a new method.

Kava

Kava (*Piper methysticum*) contains active properties - kavalactones.
- Kavalactone levels vary dependent upon the maturity of the plant and cultivar type[2].
- Kavalactones:
  - block the calcium ion channels related to reduction of neurotransmitter release excitation,
  - potentiates $GABA_A$ through enhanced ligand binding to GABA receptors,
  - reduces the neuronal reuptake of noradrenaline and possibly dopamine,
  - reverses monoamine oxidase (MAO) B inhibition[3].
- Kava produces soporific relaxant non-hallucinogenic effects similar to Benzodiazepine[4].

Kava plant and harvesting kava at three years of age

(**Source**: Yadhu Singh, 2004) (**Source**: Author, 2009)

Kava psychopharmacology

The majority of kava psychopharmacology knowledge results from studies at pharmaceutically recommended doses <300mgs kavalactones per day.
- Reaction time research at <300mgs kavalactones is inconsistent, ranging from "significantly increased" response accuracy to a 40% reduction in "reaction time ... in comparison to placebo"[5].
- Recent research reported that kavalactone "modes of action are not fully understood", even less is understood regarding "the neurophysiological mechanisms associated with kavalactone metabolism"[6].

The 2016 WHO[7] kava risk assessment report lists 28 "data gaps" and requested "further data" regarding kava ethnobotany, psychotropy, psychopharmacology and mechanisms of action related to "human health effects".

Traditional kava use and driving

Traditionally, kava is mixed by steeping or straining the crushed roots of the plant in water to make a culturally important beverage used in almost every ceremony from birth to death[4].

Kava being prepared for consumption

(**Source**: Todd Henry, 2019)

Traditionally influenced kava drinking sessions average six hours during which users consume 3.6 litres (6.33 pints) of beverage kava and in excess of 5,000mgs of kavalactones[8].
It is estimated 70% of kava users in New Zealand (NZ) and Australia drive following high traditionally influenced kava use[9].
- A Fijian based ethnographic study reported a "four-fold increase in the odds of crash involvement" following consumption of kava at cultural volumes[10].
- The New Zealand Institute of Environmental Science and Research (NZESR) reported increased detection of kavalactones in the blood of motor vehicle accident victims[11]. However, due to limited understanding of kava at high consumption volumes, the NZESR are unable to provide expert opinion on these findings.
- NZ and Pacific Island Police suspect that some unsafe driving is linked to kava use at high consumption volumes with kava also proposed as an unaccounted factor in road deaths and injury of which Pacific peoples in New Zealand are over represented[12].
- Currently there are no roadside tests to detect kava or measure kavalactone concentrations in consumers.

In a 2017 study, an industry standard measure of drug driving was administered to 20 kava users in a naturalistic setting (control group *n*=20) to assess cognitive functions[1].
- No statistical differences to reaction time and divided attention between the active and control groups were found, despite observations of slowed movement and slurred speech by the kava drinkers.

Kava drinking in New Zealand

(**Source**: Todd Henry, 2019)

The current study

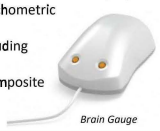
The inconsistency between the results and observations (in the 2017 study[1]) may be due to a lack of test sensitivity. This informed the identification of a novel assessment of neurological functioning – the *Brain Gauge* (*BG*).

Aim: To investigate potential methodological challenges, particularly within the naturalistic traditionally influenced kava use test setting, in a feasibility study using the *BG*.

Methods/Measures

Eldridge et al's[13] definition of a feasibility study, "in which investigators attempt to answer a question about whether some element of the future trial can be done", and Aporosa's[14] respect-based Pacific methodological framework , guided the protocol.
Experienced kava consumers (*n*=2 [males], mean age = 46.5) attended a 6 hour traditionally influenced kava session. Both participants drank 3.6 litres (6.33 pints) of kava equating to 5,220mg of kavalactones (based on HPLC analysis).
At baseline, participants completed *BG* (www.corticalmetrics.com [*CM*]) somato-sensory psychometric testing.
- *BG* measures slight changes to six strategic, tactical and operational cognitive faculties including fine-motor-skills and fatigue to assess neurological functioning.
- Each of the six domains are scored and compared against norms, which also informed a composite *CM* score.

Re-testing was conducted following 3 and 6 hours of kava consumption.



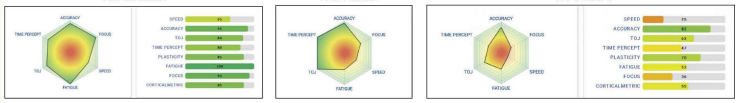
Brain Gauge

Results

Consistent with observations of the behaviour of participants in the 2017 study (utilising the industry standard measure of drug driving), obvious negative changes over time was evident for reaction time, attention focus, time perception and temporal order judgement for one participant (*CM* composite score: 85 at baseline [1a], 80 at 3 hours [1b], 55 at 6 hours [1c]).

Brain Gauge results (participant AA)

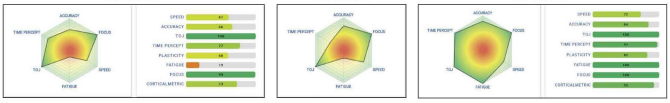
1a: Baseline 1b: 3 hours 1c: 6 hours



Alternatively, positive changes were evident for the second participant (*CM* composite score: 73 at baseline [2a], 73 at 3 hours [2b], 92 at 6 hours [2c].

Brain Gauge results (participant MA)

2a: Baseline 2b: 3 hours 2c: 6 hours



Discussion

The methods proved a robust procedure that could be effectively used to examine the effect of kava on neurological function while still maintaining the naturalistic setting of a traditional kava session.
Confounds for full scale experiments were identified:
- The need for sufficient participant numbers based on power calculations compared against control (*n*'s= ≥18).
- The introduction of a placebo driven double blinded methodology. However, as Aporosa and Tomlinson[8] explain, this "is next to impossible under the conditions in which kava is normally consumed" due to:
  - variations in kavalactone strength with limited regulation across studies,
  - kava's union with cultural values and respect which prevent a kava substitute, placebo or deception,
  - and the need for experienced kava drinkers capable of consuming large volumes of kava who would immediately recognise the absence of mouth 'tingle' produced by the interaction of selected kavalactones with oral sensory nerves[15].
- Individual participant rates of kavalactone metabolism and dose relationship of kavalactones with cognitive impact; this is knowledge that is currently beyond kava psychotropic and psychopharmacological understanding.
- (Paper discussing full list of confounds currently under review.)

Conclusion

Unlike the industry standard measure of drug driving used in the 2017 study, the *BG* is feasible in a naturalistic setting. At this stage, the challenge remains of designing a 'gold standard' double blind placebo study in a naturalistic traditional kava setting.
Funded by a NZ Health Research Council: Pasifika Award, the full controlled study has commenced.
The full study is anticipated to assist Police and NZESR in understanding kava's effects on driver safety following high consumption, and inform WHO[7] "data gaps" related to psychotropy, psychopharmacology and mechanisms of action.

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