Traditional kava use, cognition and driver fitness

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Introduction

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

Kava

Kava (*Piper methysticum*) contains psychoactive properties - kavalactones.

- Kavalactone levels vary as a function of the maturity of the plant and cultivar type[1].
- Kavalactones:
  - research has identified 20 kavalactones[2],
  - block the calcium ion channels related to reduction of neurotransmitter release excitation,
  - potentiate $GABA_A$ 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 utilising a pharmaceutically recommended tablet-dose <300mgs kavalactones per day.

- Tablet-dose kava typically contains only six (of the 20) selected and extracted kavalactones[4].
- 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 World Health Organisation[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

Traditional, or naturalistic, 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 M. Henry, 2019)

Naturalistic kava drinking sessions average six hours in which individuals typically consume 3.6 litres (6.33 pints) of beverage kava and in excess of 5,000mgs of kavalactones[8].
It is estimated that 70% of kava users in Aotearoa New Zealand and Australia drive a motorvehicle following a typical kava use session[9].

- A Fijian based ethnographic study reported a "four-fold increase in the odds of crash involvement" following consumption of kava at culturally influenced 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 impacts at high consumption volumes, the NZESR is unable to provide expert opinion on these findings.
- Both Aotearoa New Zealand 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 Aotearoa New Zealand are over represented[12].
- Currently there are no roadside tests to detect kava, or to measure kavalactone concentrations in consumers, due to limited understanding regarding "modes of action … kavalactone metabolism"[6].
- Little is known about the psychopharmacology of naturalistic kava[13].
- It is common for research findings resulting from studies that utilized pill-style kava to be applied to, and used to explain, naturalistic kava use psychophamacology. This is misleading.

In a 2017 study, an industry standard measure of drug driving was administered to kava users ('active', *n*=20) in a naturalistic setting ('control', *n*=20) to assess cognitive functions[1].

- No statistical differences in reaction time or divided attention were found between groups, despite observations of slowed movement and slurred speech by some of the kava drinkers.

100ml quantities of kava being served to participants during research data collection

(**Source**: Todd M. Henry, 2020)

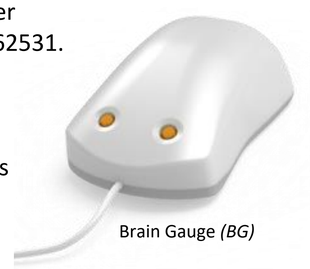
The current study

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

Aim: To measure participant neurological functioning using the *BG* during, and immediately following, naturalistic kava consumption, and apply the results to driver functionality.

Methods/Measures

- Protocol guided by Aporosa's[13] respect-based Pacific methodological framework and the *faikava methodology*[13].
- 39 male participants (*N*=40 < 1 dropout).
- Active: *n*=20, experienced kava consumers, mean age = 34.75 years (SD = 8.59).
- Control: *n*=19, mean age = 35.57 years (SD = 8.58).
- Data gathered over a 6 hour traditionally influenced naturalistic kava use session.
- Participants each drank 6 x 100ml (0.2 pints) serves per hour [= 3.6 litres (6.33 pints)] over 6 hours, equating to 3,680mg of kavalactones (based on HPLC analysis), chemotype of 462531.
- All participants screened for neurological and psychological conditions, use of anxiolytic and/or sleep medication, and adhered to washout periods.
- Baseline (T1) and testing at 3 (T2) and 6 (T3) hours using *BG* (www.corticalmetrics.com).
  - *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 is scored and compared against norms, which also informed a composite *CM* score.
- Statistical modelling based on *t*-tests (Wilcoxon and Mann-Whitney U [*MW*]), and Bayesian [*BF*] analysis.



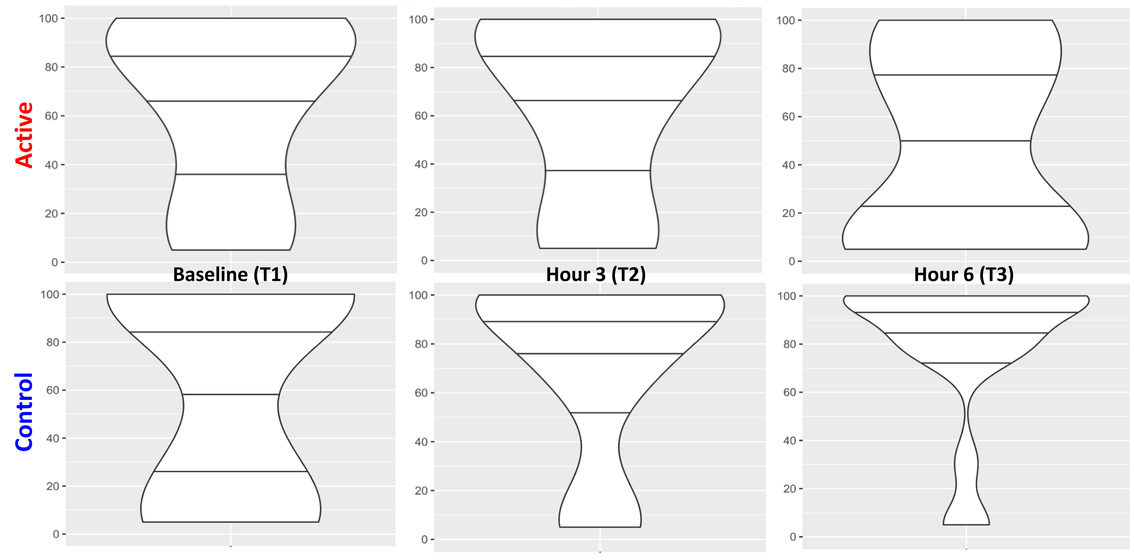
Brain Gauge *(BG)*

Results

- Data analysis showed no statistically significant difference ($p<0.05$) in five of the six cognitive factors (active participants when compared against control) at any measurement point over the six hour testing period.
- Data analysis showed a significant level of impairment to Temporal Order Judgement (TOJ) in the active participants at T3 (*MW*=**0.0119**; *t*=**0.007301**; *BF*=**6.193058**) when compared with both their own and control data at T2 and T1.

Testwise [*t*]	Focus	Accuracy	Temporal Order Judgement	Timing Perception	Plasticity	Fatigue
Control-T1 v Active-T1	0.1056	0.353	0.7854	0.3471	0.4133	0.7914
Control-T2 v Active-T2	0.2257	0.2664	0.5427	0.07599	0.3003	0.3568
Control-T3 v Active-T3	0.1243	0.6883	**0.007301**	0.4068	0.3207	0.3074

Brain Gauge results: Temporal Order Judgement (TOJ)



Discussion

Kava at traditional consumption volumes is not shown to impact Focus, Accuracy, Time Perception, Plasticity or Fatigue, although has a significant negative impact on TOJ. TOJ is associated with Executive Function "including decision making, behavioural control, and information processing" and sequencing of events[14].
Limitations:

- The absence of a placebo double blind methodology. However, as Aporosa et al.[1,13] explain, this is not possible due to kava's union with cultural values and respect preventing a kava substitute, placebo or deception, and the need for experienced kava drinkers capable of consuming large volumes of kava.
- Individual rates of kavalactone metabolism and dose relationship of kavalactones with cognitive impact; this is knowledge that is currently beyond kava psychopharmacology understanding.
- Further limitations are discussed in Aporosa et al.[1,13,15]

Conclusion

The findings of this study[15] are both unique and new and suggest kava at traditionally consumed volumes may compromises driver safety. The findings also show that kava impairment manifests vastly less impactful than alcohol, cannabis and hallucinogens[4]. While this study will go some way toward assisting Police and NZESR in understanding kava's effects on driver safety following high consumption, large knowledge gaps remain concerning kava's impacts on cognition. These gaps will remain until more is known about "the neurophysiological mechanisms associated with kavalactone metabolism"[6]. There, further research is needed. Brochures, translated into the dominant Pacific kava-using languages, have been produced to highlight the potential dangers of driving following high kava consumption.

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