

S1. Assessment of baseline differences in cognitive behaviour between treatments using paired t-tests

Task	Walnut		Control		Paired Differences (n=32)			
	Mean	SE	Mean	SE	Mean Difference	SE	t	significance
<i>AVLT recall (out of 15):</i>								
Immediate word span	7.13	0.38	6.63	0.38	0.50	0.49	1.02	ns
Total acquisition	54.47	1.59	53.88	1.43	0.59	1.42	0.42	ns
Final acquisition	13.16	0.33	13.19	0.30	-0.03	0.33	-0.10	ns
Proactive interference	0.38	0.51	0.28	0.35	0.09	0.61	0.16	ns
Retroactive interference	1.41	0.27	1.03	0.24	0.38	1.64	1.29	ns
Learning	5.91	0.39	6.34	0.47	-0.44	0.55	-0.79	ns
Delayed recall	11.06	0.55	11.22	0.50	-0.16	0.48	-0.33	ns
<i>PANAS (out of 50):</i>								
Positive affect	20.94	1.41	21.28	1.11	-0.34	1.13	-0.30	ns
Negative affect	12.65	0.48	12.84	0.49	-0.19	0.58	-0.34	ns
<i>Mental Fatigue (out of 9):</i>								
Accuracy (%)	0.97	0.01	0.97	<0.01	<0.01	<0.01	1.05	ns
RT (ms)	465.20	9.36	461.67	7.81	3.53	5.87	0.60	ns
<i>Switching task:</i>								
Accuracy (%)	0.95	0.01	0.95	0.01	<0.01	<0.01	0.87	ns
RT (ms)	774.13	27.37	800.97	26.83	-26.84	19.60	-1.37	ns

ns indicates non-significant difference $p > 0.05$

S2. Summary cognitive data from LMM analyses. Reported values are estimated marginal means with baseline performance included as covariate

Task	Walnut						Control						LMM Fixed Effects Related to Treatment		
	2h		4h		6h		2h		4h		6h		Treatment	Treatment x Time	Other Treatment Interactions
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
<i>AVLT recall (out of 15):</i>															
Immediate word span	6.54	0.29	6.57	0.29	6.89	0.29	6.43	0.27	6.83	0.27	6.55	0.27	ns	ns	n/a
Total acquisition	49.79	1.35	52.16	1.35	53.47	1.36	52.42	1.18	53.86	1.18	51.52	1.18	ns	ns	n/a
Rate of acquisition	9.98	0.23	10.53	0.23	10.75	0.24	10.49	0.23	10.76	0.23	10.32	0.23	ns	p < 0.001	ns
Final acquisition	12.72	0.29	13.45	0.30	13.21	0.30	13.02	0.27	13.24	0.27	13.01	0.27	ns	ns	n/a
Proactive interference	-0.37	0.33	-0.06	0.33	-0.26	0.34	0.16	0.31	0.22	0.31	-0.25	0.31	ns	ns	n/a
Retroactive interference	2.01	0.32	1.63	0.32	1.85	0.33	1.72	0.36	1.28	0.36	1.78	0.36	ns	ns	n/a
Learning	6.07	0.42	6.35	0.42	6.02	0.42	6.44	0.40	6.15	0.40	6.28	0.40	ns	ns	n/a
Delayed recall	9.18	0.58	10.30	0.58	10.21	0.58	9.62	0.55	9.90	0.55	9.93	0.55	ns	ns	n/a
<i>AVLT delayed recognition:</i>															
Accuracy (%)	0.92	0.01	0.93	0.01	0.93	0.01	0.93	0.01	0.93	0.01	0.94	0.01	ns	ns	ns
RT (ms)	894.45	20.25	850.48	20.14	856.99	20.31	878.98	21.17	881.94	21.11	861.77	21.12	ns	ns	ns
<i>MANT:</i>															
Accuracy (%)	0.96	0.01	0.96	0.01	0.96	0.01	0.96	0.01	0.96	0.01	0.96	0.01	ns	ns	T x Load: p = 0.030
RT (ms)	455.39	5.55	458.71	5.54	452.25	5.55	469.19	5.69	463.19	5.69	458.49	5.69	p < 0.001	ns	ns
<i>Switching task:</i>															
Accuracy (%)	0.94	0.01	0.94	0.01	0.94	0.01	0.93	0.01	0.93	0.01	0.94	0.01	ns	ns	ns
RT (ms)	765.80	13.76	771.11	13.74	755.80	13.83	787.80	13.71	800.01	13.71	771.14	13.69	p < 0.001	ns	ns

ns indicates non-significant effect $p > 0.05$; T: Treatment

S3. Summary mood data from LMM analyses. Reported values are estimated marginal means with baseline mood included as covariate

Measure	Walnut						Control						LMM Fixed Effects Related to Treatment		
	2h		4h		6h		2h		4h		6h		Treatment	Treatment x Time	Other Treatment Interactions
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
PANAS (out of 50):															
Positive affect	19.12	0.92	18.93	0.92	20.55	0.94	20.20	1.01	17.54	1.01	20.60	1.01	ns	ns	n/a
Negative affect	12.36	0.38	12.37	0.39	12.52	0.39	11.81	0.28	11.76	0.27	10.95	0.28	p = 0.001	ns	n/a
Mental Fatigue (out of 9):															
	6.49	0.33	6.65	0.33	6.08	0.33	6.23	0.32	6.30	0.32	5.95	0.32	ns	ns	n/a

ns indicates non-significant effect $p > 0.05$

S4. Summary EEG data from LMM analyses. Reported values are estimated marginal means with baseline EEG signal included as covariate

Measure	Walnut						Control						LMM Fixed Effects Related to Treatment		
	2h		4h		6h		2h		4h		6h		Treatment	Treatment x Time	Other Treatment Interactions
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
RAVLT Immediate Recall: PSD															
Frontal:															
Alpha	8.04	0.92	7.78	0.94	6.81	0.94	6.20	0.68	5.92	0.69	6.62	0.68	p = 0.006	ns	ns
Gamma	0.31	0.04	0.32	0.04	0.32	0.04	0.30	0.04	0.30	0.04	0.34	0.04	ns	ns	ns
Delta	201.19	37.42	228.56	37.81	237.17	38.08	176.30	30.40	172.49	30.82	173.27	30.59	p = 0.006	ns	ns
Theta	15.23	1.60	14.02	1.63	13.77	1.63	11.84	1.41	10.74	1.43	13.94	1.43	p = 0.019	ns	ns
Parietal:															
Alpha	5.620	0.31	5.808	0.312	5.480	0.313	6.073	0.313	5.761	0.314	6.085	0.314	p = 0.01	ns	ns
Gamma	0.07	< 0.001	0.08	< 0.001	0.07	< 0.001	0.07	< 0.001	0.07	< 0.001	0.07	< 0.001	ns	ns	ns
Delta	29.24	1.52	28.57	1.54	29.86	1.54	30.97	1.60	26.77	1.60	27.93	1.59	ns	ns	ns
Theta	4.45	0.19	4.60	0.19	4.52	0.19	4.64	0.20	4.56	0.20	4.84	0.20	ns	ns	ns
Temporal:															
Theta	8.16	0.84	8.06	0.86	9.26	0.86	8.14	0.61	7.73	0.61	8.50	0.61	ns	ns	ns
RAVLT Delayed Recall: PSD															
Frontal:															
Alpha	9.91	1.21	9.31	1.22	7.29	1.21	7.00	0.77	6.72	0.78	7.68	0.77	p = 0.003	p = 0.037	ns
Gamma	0.27	0.06	0.42	0.06	0.34	0.06	0.32	0.05	0.32	0.05	0.36	0.05	ns	ns	ns
Delta	249.61	49.01	251.36	49.94	186.38	49.51	160.48	34.52	156.71	35.33	191.68	34.52	p = 0.033	ns	ns
Theta	15.40	1.77	14.24	1.81	14.06	1.77	11.35	1.38	10.74	1.40	12.58	1.39	p = 0.002	ns	ns
Parietal:															
Alpha	6.11	0.39	6.41	0.39	6.22	0.39	5.70	0.37	5.95	0.37	5.83	0.37	p = 0.02	ns	ns
Gamma	0.06	0.01	0.08	0.01	0.08	0.01	0.07	0.01	0.07	0.01	0.08	0.01	ns	ns	ns
Delta	30.82	2.15	34.73	2.16	30.30	2.17	31.59	1.98	30.47	1.98	30.43	1.98	ns	p = 0.03	ns
Theta	4.78	0.20	5.17	0.21	4.93	0.21	4.75	0.19	4.55	0.19	5.04	0.19	ns	p = 0.03	ns
Temporal:															
Theta	8.54	0.50	9.23	0.51	8.54	0.51	8.01	0.50	8.11	0.51	8.08	0.51	p = 0.004	ns	ns

Measure	Walnut						Control						LMM Fixed Effects Related to Treatment		
	2h		4h		6h		2h		4h		6h		Treatment	Treatment x Time	Other Treatment Interactions
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
RAVLT Delayed Recognition: PSD															
Frontal:															
Alpha	5.64	0.60	5.42	0.60	4.89	0.60	4.95	0.55	4.90	0.56	5.31	0.56	ns	ns	ns
Gamma	0.19	0.03	0.18	0.03	0.16	0.03	0.22	0.03	0.24	0.03	0.22	0.03	p = 0.017	ns	ns
Delta	58.03	7.20	49.73	7.12	38.89	7.19	46.05	7.43	44.45	7.46	45.29	7.37	ns	ns	ns
Theta	11.32	1.14	9.89	1.13	8.24	1.15	9.69	1.11	8.89	1.13	9.94	1.12	ns	ns	ns
Parietal:															
Alpha	4.19	0.26	4.13	0.26	4.17	0.26	4.22	0.27	4.63	0.27	4.51	0.27	p = 0.001	ns	ns
Gamma	0.03	< 0.001	0.04	< 0.001	0.03	< 0.001	0.04	< 0.001	0.04	< 0.001	0.04	< 0.001	ns	ns	ns
Delta	17.80	0.74	17.83	0.74	17.37	0.74	17.81	0.77	16.20	0.77	16.74	0.77	ns	ns	ns
Theta	4.65	0.24	4.82	0.24	5.00	0.24	5.07	0.24	4.83	0.24	5.24	0.24	p = 0.04	ns	ns
Temporal:															
Theta	7.61	0.92	7.91	0.92	7.31	0.92	7.91	0.92	7.45	0.92	7.97	0.92	ns	p = 0.03	ns
MANT: PSD															
Frontal:															
Alpha	10.47	1.38	9.27	1.39	9.06	1.40	8.08	1.08	7.82	1.09	8.69	1.09	p = 0.023	ns	ns
Gamma	0.26	0.03	0.27	0.03	0.24	0.03	0.25	0.04	0.26	0.04	0.27	0.04	ns	ns	ns
Delta	99.30	16.81	99.30	16.59	87.58	16.81	88.62	14.48	77.34	14.84	82.41	14.60	ns	ns	ns
Theta	12.90	1.35	10.63	1.32	9.67	1.34	9.96	1.14	8.99	1.16	10.42	1.15	ns	ns	ns
Parietal:															
Alpha	7.96	0.35	7.94	0.35	8.30	0.35	7.66	0.36	8.18	0.37	8.44	0.37	ns	ns	ns
Gamma	0.05	0.01	0.05	0.01	0.04	0.01	0.05	< 0.001	0.04	< 0.001	0.05	< 0.001	ns	ns	ns
Delta	25.65	1.39	24.33	1.38	22.53	1.39	25.35	1.32	23.77	1.33	24.99	1.32	ns	ns	ns
Theta	5.37	0.28	5.03	0.29	5.19	0.29	5.16	0.27	4.94	0.27	5.35	0.27	ns	ns	ns
Switching task: PSD															
Frontal:															
Alpha	9.46	1.03	9.08	1.04	8.52	1.05	8.15	0.80	7.56	0.81	8.89	0.81	ns	ns	ns

Measure	Walnut						Control						LMM Fixed Effects Related to Treatment		
	2h		4h		6h		2h		4h		6h		Treatment	Treatment x Time	Other Treatment Interactions
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE			
Gamma	0.37	0.05	0.38	0.05	0.33	0.05	0.36	0.05	0.36	0.05	0.37	0.05	ns	ns	ns
Delta	177.09	32.31	177.43	32.31	165.72	32.49	152.01	36.24	164.50	36.37	155.30	36.34	ns	ns	ns
Theta	15.52	1.72	15.51	1.73	14.38	1.75	14.37	1.68	13.19	1.70	16.04	1.68	ns	ns	ns
Parietal:															
Alpha	6.87	0.42	7.38	0.42	7.20	0.43	7.21	0.38	7.26	0.38	7.35	0.38	ns	ns	ns
Gamma	0.07	0.01	0.06	0.01	0.06	0.01	0.06	< 0.001	0.06	< 0.001	0.06	< 0.001	ns	ns	ns
Delta	37.73	3.38	42.25	3.37	33.89	3.43	35.02	2.25	33.15	2.26	32.09	2.25	p = 0.01	ns	ns
Theta	6.26	0.33	6.16	0.34	6.06	0.34	6.18	0.30	6.01	0.30	6.36	0.30	ns	ns	ns

ns indicates non-significant effect $p > 0.05$; TxH: Treatment x Hemisphere

S5. Summary data for Biomarkers of inflammation, metabolism, and brain function from LMM analyses. Reported values are estimated marginal means with baseline biomarker concentrations included as covariate

Parameter	Walnut						Control						LMM Fixed Effects Related to Treatment	
	2h (n=11)		4h (n=10)		6h (n=11)		2h (n=11)		4h (n=10)		6h (n=11)		Treatment	Treatment x Time
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE		
<i>BDNF</i>	41.86	2.09	43.17	2.36	46.61	2.13	39.79	2.70	44.62	3.01	45.48	2.72	ns	ns
<i>IL-6</i>	1.09	0.21	0.94	0.22	1.53	0.19	0.93	0.18	0.83	0.20	1.32	0.18	ns	ns
<i>CRP</i>	1.70	0.29	1.33	0.31	1.18	0.31	1.12	0.02	1.12	0.02	1.15	0.02	ns	ns
<i>Glucose</i>	4.79	0.16	5.71	0.17	4.84	0.16	4.71	0.12	5.31	0.14	4.61	0.12	p = 0.023	ns
<i>NEFA</i>	0.34	0.04	0.21	0.04	0.18	0.04	0.39	0.05	0.28	0.05	0.21	0.04	p = 0.019	ns

ns indicates non-significant effect p > 0.05

S6. Summary appetite and palatability data from LMM analyses. Reported values are estimated marginal means with baseline ratings included as covariate

Appetite Data:

Measure	Walnut												Control												LMM Fixed Effects Related to Treatment	
	Breakfast		2h		Lunch		4h		6h		End		Breakfast		2h		Lunch		4h		6h		End		T	TxTi
	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE		
<i>Hungry</i>	27.47	4.10	41.15	4.10	31.04	4.14	37.83	4.10	51.76	4.14	52.59	4.14	28.97	4.01	42.65	4.01	27.70	4.01	30.57	4.01	45.19	4.01	50.98	4.01	ns	ns
<i>Satisfied</i>	66.96	3.59	51.17	3.59	62.18	3.63	54.27	3.59	45.98	3.63	41.70	3.63	62.51	3.85	50.42	3.85	61.61	3.85	60.26	3.85	47.87	3.85	40.65	3.85	ns	ns
<i>Full</i>	63.99	3.91	48.72	3.91	60.02	3.94	53.74	3.91	44.81	3.94	40.68	3.94	62.15	4.03	45.88	4.03	62.69	4.03	58.71	4.03	46.40	4.03	38.63	4.03	ns	ns
<i>How much more</i>	36.80	3.82	49.16	3.82	46.90	3.86	51.59	3.82	57.31	3.86	63.86	3.86	37.55	3.87	55.65	3.87	42.45	3.87	48.30	3.87	64.40	3.87	61.94	3.87	ns	ns
<i>Sweet craving</i>	61.14	4.86	58.36	4.86	49.40	4.91	49.69	4.86	49.14	4.91	48.84	4.91	63.72	5.02	65.14	5.02	51.53	5.02	57.69	5.02	50.88	5.02	49.02	5.02	ns	ns
<i>Savoury craving</i>	50.18	4.56	47.85	4.56	57.08	4.61	55.65	4.56	49.15	4.61	47.03	4.61	47.89	4.58	40.66	4.58	55.41	4.58	58.81	4.58	47.53	4.58	44.67	4.58	ns	ns
<i>Fatty craving</i>	66.72	4.17	63.26	4.17	61.83	4.20	62.52	4.17	62.40	4.20	59.63	4.20	67.67	3.92	64.29	3.92	69.17	3.92	68.65	3.92	62.25	3.92	62.00	3.92	p = 0.025	ns
<i>Salty craving</i>	63.82	4.64	57.88	4.64	59.28	4.67	68.16	4.64	64.33	4.68	61.15	4.68	55.81	4.65	54.20	4.65	64.79	4.65	69.96	4.65	60.08	4.65	60.69	4.65	ns	ns

ns indicates non-significant effect p > 0.05; T: Treatment; Ti: Time

Palatability Data:

Measure	Walnut		Control		LMM Main Effect of Treatment
	Mean	Standard Error	Mean	Standard Error	
<i>Visual appeal</i>	66.73	3.73	71.36	3.01	ns
<i>Smell</i>	55.11	3.66	43.92	3.70	p = 0.004
<i>Taste</i>	51.63	5.08	41.94	3.95	ns
<i>Aftertaste</i>	59.76	4.17	56.51	3.49	ns
<i>Palatability</i>	52.08	4.34	44.36	3.93	ns

ns indicates non-significant effect p > 0.05

S7. Pearson r correlations between cognitive variables and biomarkers for the walnut intervention. All correlations were performed using change-from-baseline data at 2h, 4h, or 6h timepoints depending on participant allocation

[illegible]

NEFA	Pearson Correlation	.141	-.024	.097	-.067	.137	-.345	.293	--		
	Sig. (2-tailed)	.531	.916	.668	.768	.544	.116	.186			
	N	22	22	22	22	22	22	22	22		
Glucose	Pearson Correlation	.171	-.151	.122	.298	.000	-.152	.063	-.189	--	
	Sig. (2-tailed)	.447	.502	.587	.178	.999	.500	.782	.400		
	N	22	22	22	22	22	22	22	22	22	
BDNF	Pearson Correlation	.254	.109	.318	-.201	.219	-.141	-.293	-.019	.059	--
	Sig. (2-tailed)	.253	.630	.149	.370	.326	.531	.186	.933	.796	
	N	22	22	22	22	22	22	22	22	22	22

*. Correlation is significant at the 0.05 level (2-tailed).

S8. Pearson r correlations between cognitive variables and biomarkers for the control intervention. All correlations were performed using change-from-baseline data at 2h, 4h, or 6h timepoints depending on participant allocation

		Correlations									
		RAVLT Immediate Recall	RAVLT Delayed Recall	RAVLT Delayed Recognition	MANT RT	TST RT	IL-6	CRP	NEFA	Glucose	BDNF
RAVLT Immediate Recall	Pearson Correlation	--									
	N	24									
RAVLT Delayed Recall	Pearson Correlation	.280	--								
	Sig. (2-tailed)	.185									
	N	24	24								
RAVLT Delayed Recognition	Pearson Correlation	.338	.414*	--							
	Sig. (2-tailed)	.106	.044								
	N	24	24	24							
MANT RT	Pearson Correlation	-.110	-.384	-.360	--						
	Sig. (2-tailed)	.610	.064	.084							
	N	24	24	24	24						
TST RT	Pearson Correlation	.281	-.120	.239	.307	--					
	Sig. (2-tailed)	.184	.577	.260	.145						
	N	24	24	24	24	24					
IL-6	Pearson Correlation	-.228	-.061	-.198	-.028	-.064	--				
	Sig. (2-tailed)	.284	.776	.355	.895	.767					
	N	24	24	24	24	24	24				
CRP	Pearson Correlation	-.203	-.063	-.005	.002	-.283	-.302	--			
	Sig. (2-tailed)	.341	.768	.980	.992	.180	.151				
	N	24	24	24	24	24	24	24			
NEFA	Pearson Correlation	.237	-.444*	-.235	.183	.318	.156	-.432*	--		

	Sig. (2-tailed)	.264	.030	.270	.393	.130	.466	.035			
	N	24	24	24	24	24	24	24	24		
Glucose	Pearson Correlation	-.106	-.050	.167	.034	-.196	-.034	-.061	-.221	--	
	Sig. (2-tailed)	.621	.818	.436	.873	.358	.874	.778	.300		
	N	24	24	24	24	24	24	24	24	24	
BDNF	Pearson Correlation	.022	.309	.361	-.533**	-.031	.134	.082	-.014	-.049	--
	Sig. (2-tailed)	.917	.142	.083	.007	.887	.533	.702	.948	.819	
	N	24	24	24	24	24	24	24	24	24	24

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).