Supplementary Table 1. Volatile compounds of cocoa beans after treatment with papain (concentration 3.3 U/mL for 10 hours incubation) compared with that of unfermented and fermented cocoa.

Compounds	KI^{exp}	KI^{lit}	Concentration (ng/g)			*Odor description
			Unfermented	Fermented	Papain treatment	
Pyrazine						
2,5-dimethyl- Pyrazine	**1,320**	**1,323**	**0.16 ± 0.00^{a}**	**0.30 ± 0.05^{c}**	**0.22 ± 0.00^{b}**	Chocolate, nutty
2,6-dimethyl-Pyrazine	1,325	1,328	0.02 ± 0.00^{a}	0.13 ± 0.15^{b}	0.03 ± 0.00^{a}	Nutty, coffee
ethyl-Pyrazine	**1,330**	**-**	**0.01 ± 0.00^{a}**	**0.11 ± 0.09^{c}**	**0.04 ± 0.01^{b}**	Peanut-butter, nutty
2,3-dimethyl- Pyrazine	**1,339**	**1,315-1,345**	**0.04 ± 0.00^{a}**	**0.31 ± 0.33^{c}**	**0.14 ± 0.01^{b}**	Cocoa, caramel
2-ethyl-5-methyl-Pyrazine	**1,372**	**1,386**	**0.01 ± 0.00^{a}**	**0.12 ± 0.01^{c}**	**0.03 ± 0.00^{b}**	Nutty, raw potato
trimethyl-Pyrazine	**1,390**	**1,395-1,403**	**0.02 ± 0.00^{a}**	**1.67 ± 0.17^{c}**	**0.08 ± 0.00^{b}**	Cocoa, roasted nuts, peanut
3-ethyl-2,5-dimethyl-Pyrazine	**1,444**	**-**	**0.03 ± 0.00^{a}**	**0.39 ± 0.26^{c}**	**0.07 ± 0.00^{b}**	cocoa roasted, nutty
tetramethyl-Pyrazine	**1,460**	**1,438-1,465**	**0.05 ± 0.01^{a}**	**7.08 ± 0.40^{c}**	**0.17 ± 0.00^{b}**	chocolate, cocoa, roasted
Total			**0.34**	**10.66**	**0.78**	
Aldehid						
3-methylbutanal*	**916**	**912-937**	**-**	**4.05 ± 0.087^{a}**	**1.6 ± 0.10^{b}**	**Cocoa, chocolate**
Benzaldehyde	**1,498**	**1,495-1,499**	**0.06 ± 0.04^{a}**	**3.73 ± 0.61^{c}**	**0.69 ± 0.01^{b}**	Sweet, almond, cherry, bitter
Benzeneacetaldehyde	**1,621**	**1,609-1,671**	**0.12 ± 0.03^{a}**	**1.64 ± 0.67^{c}**	**0.68 ± 0.12^{b}**	Almond, fruity, nutty
2-Phenyl-2-butenal	**1,925**	**1,896-1,972**	**-**	**0.70 ± 0.22^{a}**	**0.05 ± 0.01^{b}**	**Sweet chocolate**
Total			**0.18**	**11.89**	**3.02**	
Ester						
Isobutyl acetate	1,011	1,008	0.02 ± 0.01^{a}	0.07 ± 0.01^{b}	0.03 ± 0.00^{a}	Fruity

2-pentyl acetate	**1,071**	**1,073-1,080**	**0.02 ± 0.06^{b}**	**0.67 ± 0.62^{a}**	**0.18 ± 0.01^{a}**	Fruity, orange, tropical
Isoamyl acetate	**1,122**	**1,118-1,137**	**-**	**2.74 ± 0.45^{a}**	**0.89 ± 0.07^{b}**	Banana, fruity
Total			**0.04**	**5.19**	**1.1**	
Alcohol						
2-Ethyl-1-pentanol	1,297	-	0.04 ± 0.01^{a}	0.08 ± 0.02^{b}	0.04 ± 0.01^{a}	-
2-Heptanol	1,322	1,315-1,326	0.02 ± 0.01^{a}	0.54 ± 0.34^{b}	0.03 ± 0.00^{a}	Citrus, fruity, lemon grass
2-Nonanol	**1,509**	**-**	**-**	**0.82 ± 0.44^{b}**	**0.03 ± 0.00^{a}**	**Citrus, orange, waxy**
2-Hexanol	**1,528**	**-**	**-**	**0.23 ± 0.09^{b}**	**0.03 ± 0.01^{a}**	**Fruity, green, herbal**
Benzyl alcohol	1,869	1,840-1,864	0.04 ± 0.01^{a}	0.23 ± 0.16^{b}	0.04 ± 0.01^{a}	Sweet, flowery
Phenylethyl alcohol	**1,907**	**-**	**0.18 ± 0.08^{a}**	**3.39 ± 0.59^{c}**	**1.48 ± 0.33^{b}**	Floral, sweet, and bready
Isoamyl alcohol	**1,211**	**-**	**0.04 ± 0.08^{a}**	**0.24 ± 0.28^{b}**	**0.55 ± 0.15^{c}**	**Banana, fruity, fermented**
2,3 butanediol	**1,575**	**1,516-1,582**	**0.03 ± 0.04^{a}**	**0.77 ± 0.27^{c}**	**0.05 ± 0.02^{b}**	**fruity, sweet, butter**
Total			**0.35**	**6.3**	**2.25**	
ketones						
2-Heptanone	1,183	1,145-1,216	0.08 ± 0.01^{a}	0.31 ± 0.23^{c}	0.11± 0.02^{b}	Fruity, coconut, floral, cheesy
Acetoin	**1,284**	**1,250-1,255**	**0.03 ± 0.00^{a}**	**0.56 ± 0.25^{c}**	**0.09 ± 0.02^{b}**	**Buttery and creamy**
2-Nonanone	**1,376**	**1,347-1,420**	**0.01 ± 0.02^{a}**	**1.2 ± 0.45^{c}**	**0.04 ± 0.01^{b}**	**Fruity, fresh, sweet**
Acetophenone	**1,631**	**1,600-1,655**	**0.30 ± 0.02^{a}**	**1.03 ± 0.20^{c}**	**0.73 ± 0.03^{b}**	**Floral, flowery, sweet**
Total			**0.42**	**3.1**	**0.97**	
Acids						
Acetic acid	**1,430**	**1,430-1,452**	**0.13 ± 0.04^{a}**	**3.50 ± 0.77^{c}**	**1.80 ± 0.59^{b}**	Sour, astringent, vinegar

Propanoic acid	1,521	1,514-1,523	-	0.12 ± 0.07[a]	0.04 ± 0.00[b]	Pungent and rancid
Isovaleric acid	**1,660**	**-**	**0.12 ± 0.06[a]**	**3.06 ± 0.65[c]**	**0.26 ± 0.04[b]**	Sweat, acid and rancid
3-methylpentanoic acid	1,845	-	-	0.39 ± 0.18[a]	0.09 ± 0.01[b]	-
Total			**0.25**	**7.07**	**2.19**	
Other						
2-Acetylpyrrole	1,964	1,930-2,020	0.06 ± 0.03	0.55 ± 0.29	0.08 ± 0.02	cocoa, chocolate, hazelnut, roasted
Furaneol	2,343	-	0.03 ± 0.01	0.13 ± 0.01	0.06 ± 0.02	caramel-like, sweet
Total			**0.25**	**7.07**	**2.19**	

Significance: Value with different letters represent significant differences ($\alpha = 0.05$) in between samples; $KI^{(exp)}$: Kovat retention Index on the DB-WAX column; $KI^{(lit)}$: Kovat retention Index literature sourced from http://www.pherobase.com accessed on March 2023 (Hinneh et al., 2018; Tuenter et al., 2020); *odor description from Afoakwa et al. (2008), Aprotosoaie et al. (2016), Rottiers et al. (2019), and http://www.thegoodscentscompany.com accessed on March 2023