SUPPORTING INFORMATION FOR

Ethanol, Isobutanol, and Biohydrocarbons as Gasoline Components in Relation to Gaseous Emissions and Particulate Matter

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FFV car conditioning. Conditioning of The FFV car model used in this project requires special adaptation to fuel. Instructions from the manufacturer included driving in on-road conditions before preconditioning on the chassis dynamometer. The adaptation of the car to new fuel was monitored by the following parameters: charge air pressure, ignition timing, injection time and long- and short-term adjustment for fuel adaptation. Measurements were conducted after changing fuel and preconditioning at three constant loads (idle, 10 kW and 30 kW) using an Autocom OBD tester. In addition, data were recorded continuously during selected test runs using an ELM OBD diagnostic card. With the FFV car, charge air pressure was relatively constant for all fuels measured. The ignition timing was at the same level at idle and at 10 kW load. At the highest load (30 kW), the most significant difference was observed for the E30 fuel. These parameters were not measured for the E85 fuel.

Ames test in the mutagenicity testing. Ames test has been most widely used short-term test for screening of chemicals and various kind of complex environmental samples for mutagenicity. It provides a practical screening tool, but when interpreting the results of the test one need to know its limitations. The following is a summary of the more detailed discussion of this subject presented in a report by Aakko et al. 2006 (Aakko, P., Harju, T., Niemi, M., Rantanen-Kolehmainen, L. PAH content of diesel fuel and automotive emissions. Research report: VTT-R-1155-06, http://www.vtt.fi/inf/julkaisut/muut/2006/VTT-1155-06-AROM.pdf).

Mutagenicity is a term related to genotoxicity and carcinogenesis. A large number of mutagenicity tests are available. The bacterial reverse mutation tests, such as Ames test are in vitro tests that are commonly used as screening tools for genotoxic and mutation inducing activity. There are several drawbacks of using Ames test to study mutagenicity. The bacterial test does not reflect in vivo mutagenic activity, or show good correlation with the rodent cancer bioassay. The bacterial test is indicating narrow initiation phase mutations, not the whole process of carcinogenesis. Proper testing of genetic and carcinogenic risks should include a) the bacterial test b) in vitro tests using mammalian cells c) in vivo tests. However, bacteria tests can be used as effective first-step screening tool for bacterial mutagenicity as they are relatively simple and inexpensive. There have been a lot of studies on reliability of these tests, e.g. comparisons with the rodent cancer bioassays. Relatively low correlation has been showed between mutagenicity in bacteria and carcinogenicity in rodents in some studies, e.g. one study with 301 chemicals reported that the bacterial tests detected 56% of the carcinogens and 70% of those that were carcinogenic in both mice and rats. Generally, one important shortcoming of the bacterial test is lack of detection of nongenotoxic mechanisms. In addition, in vitro bacterial test has a high sensitivity and thus tends to overestimate in vivo activity. The following differences between bacterial tests and in vivo circumstances should be considered:

a) Dose in bacterial tests is “unlimited”, whereas in the rodent cancer bioassay there as many limitations. Unrealistically high dose may lead to overestimated response, and even impurities may reach levels that show mutagenic response

b) Tissue-specific: some bacterial mutagens show low in vivo activity

c) Metabolic activation is often needed to convert compounds reactive for DNA.

d) The test material is added directly to the target cells in vitro, whereas in vivo, the reaction with DNA depend on the stability of the metabolite, the travelling distance and the availability of other trapping groups than DNA.

e) The mutation is a competition between DNA replication (mutation) and DNA repair. Most bacteria tests lack DNA repair systems.

TABLE S1. Test fuels.

	Bio-energy	Biocomponent share	Oxygen	Density	Vapor pressure	Distillation 10 v/v%	Distillation 50 v/v%	Distillation 95 v/v%	Aro-matics	Ben-zene	RON/MON
	E%	v/v%	m/m%	g/l	kPa	°C	°C	°C	v/v%	v/v%	
Fossil	0	0	0.1	736	78	43	98	164	33	0.5	95/86
E10	7	10	3.7	754	69	47	80	161	27	0.2	97/86
E10+R	22	26	4.0	749	69	50	84	164	33	0.4	95/86
iBu	14	17	3.8	756	69	48	91	161	29	0.45	97/86
E30	23	31	11.3	754	68	55	74	162	20	0.3	103/90
E85	78	85	29.8	788	34	75	78	80	5	0.1	n.a.

E = ethanol, iB = isobutanol, R = renewable hydrocarbons. Number indicates volume of biocomponent.

TABLE S2. Characteristics of cars.

	MPFI	DISI	FFV
Model year	2010	2010	2006
Displacement, litres	1.6	1.4	2.0
Engine	4-cyl., 16-v, DOHC, Valvematic	4-cyl.	4-cyl., turbo-charged
Fuel system	Multi-point fuel injection	Gasoline direct injection	Multi-point fuel injection
Power, kW/min^{-1}	97/6400	90/5000	132/5500
Torque, Nm/min^{-1}	160/4400	200/1500-4000	280/1800
Odometer, km	5 300	21 400	62 000
Emission level	EU5	EU5	EU4

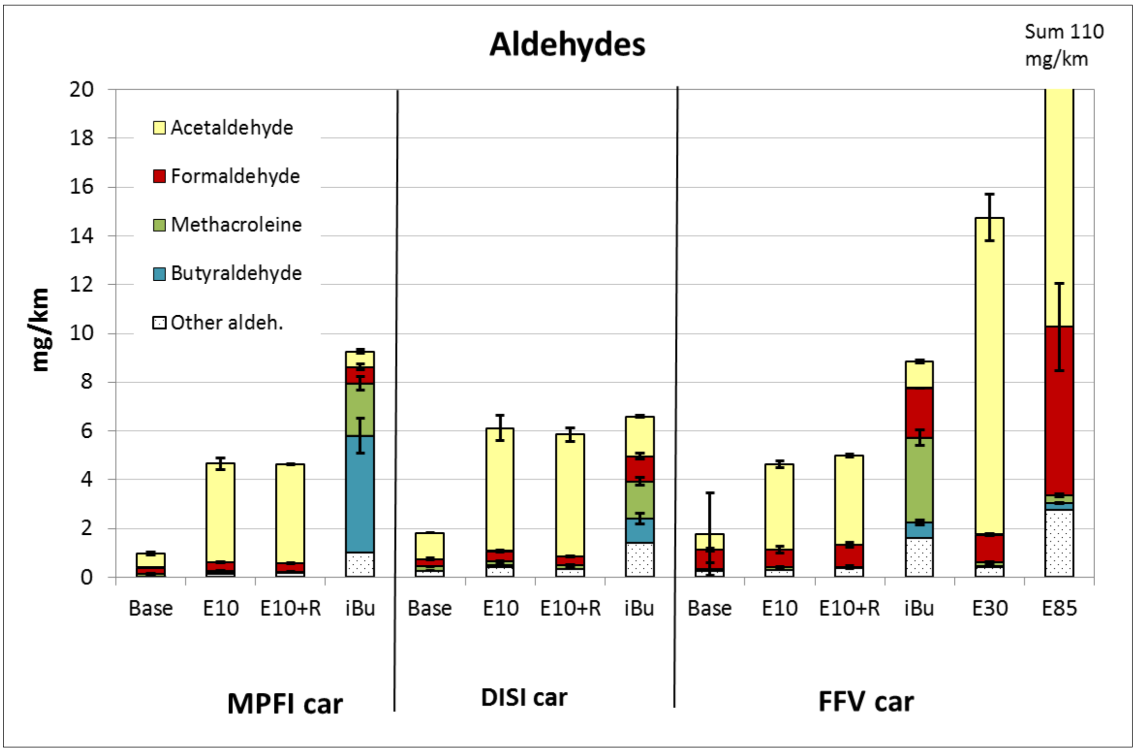

Figure S1. Aldehyde emissions from the MPFI, DISI and FFV cars over the European test cycle at -7 °C. Standard deviations of individual aldehydes are presented as error bars, if replicate tests are available (number of replicate tests in Table 2).

TABLE S3. CO, HC, NMHC, NOx, PM and tailpipe CO_2 emissions (g/km)[b].

	No[a]	CO	HC	NMHC	NO_x	PM	CO_2 tailpipe
MPFI car							
Base	2	1,27	0,39	0,38	0,02	0,003	204
		(±0,08)	(±0,00)	(±0,00)	(±0,00)	(±0,000)	(±1,49)
E10	2	1,02	0,39	0,37	0,03	0,004	203
		(±0,02)	(±0,01)	(±0,00)	(±0,00)	(±0,000)	(±1,19)
E10+R	3	1,09	0,40	0,38	0,03	0,003	205
		(±0,01)	(±0,01)	(±0,01)	(±0,00)	(±0,000)	(±0,28)
iBu	4	0,83	0,38	0,35	0,04	0,006	202
		(±0,10)	(±0,03)	(±0,02)	(±0,00)	(±0,003)	(±1,33)
DISI car							
Base	2	3,90	0,59	0,56	0,06	0,016	169
		(±0,03)	(±0,01)	(±0,01)	(±0,00)	(±0,000)	(±0,33)
E10	3	3,06	0,52	0,49	0,07	0,013	170
		(±0,16)	(±0,02)	(±0,03)	(±0,00)	(±0,001)	(±0,69)
E10+R	3	2,72	0,55	0,52	0,08	0,015	171
		(±0,13)	(±0,01)	(±0,00)	(±0,01)	(±0,002)	(±0,92)
iBu	3	2,91	0,55	0,50	0,07	0,014	170
		(±0,05)	(±0,04)	(±0,04)	(±0,00)	(±0,001)	(±0,92)
FFV car							
Base	2	2,21	0,28	0,26	0,11	0,003	251
		(±0,04)	(±0,01)	(±0,02)	(±0,01)	(±0,003)	(±0,95)
E10	3	2,32	0,30	0,29	0,10	0,003	255
		(±0,11)	(±0,02)	(±0,00)	(±0,00)	(±0,000)	(±1,02)
E10+R	3	2,30	0,32	0,29	0,09	0,004	254
		(±0,20)	(±0,00)	(±0,00)	(±0,01)	(±0,000)	(±0,41)
iBu	3	2,31	0,36	0,34	0,08	0,004	251
		(±0,09)	(±0,03)	(±0,03)	(±0,01)	(±0,000)	(±1,53)
E30	2	3,24	0,42	0,34	0,07	0,004	248
		(±0,15)	(±0,01)	(±0,00)	(±0,00)	(±0,000)	(±0,82)
E85	2	5,55	2,40	0,51	0,05	0,007	247
		(±0,29)	(±0,20)	(±0,00)	(±0,01)	(±0,000)	(±1,28)

[a]Number of data points. [b]Mean and standard deviation.

TABLE S4. Aldehyde emissions (mg/km).[b]

	No[a]	Form-aldehyd	Acetal-dehyde	Acrolein	Propion-aldehyde	Croton-aldehyde	Methac-roleine	Butyr-aldehyde	Benz-aldehy	Sum
MPFI car										
Base	2	0,3 (±0,0)	0,6 (±0,1)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	1,0 (±0,1)
E10	2	0,4 (±0,0)	4,0 (±0,2)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	4,7 (±0,3)
E10+R	3	0,4 (±0,0)	4,1 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	4,6 (±0,0)
iBu	4	0,7 (±0,1)	0,6 (±0,1)	0,1 (±0,1)	0,8 (±0,1)	0,0 (±0,0)	2,1 (±0,3)	4,8 (±0,7)	0,1 (±0,1)	9,3 (±0,6)
DISI car										
Base	2	0,3 (±0,0)	1,1 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	0,0 (±0,0)	0,2 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	1,8 (±0,1)
E10	3	0,4 (±0,0)	5,0 (±0,5)	0,1 (±0,0)	0,2 (±0,0)	0,0 (±0,0)	0,2 (±0,0)	0,1 (±0,1)	0,2 (±0,0)	6,1 (±0,6)
E10+R	3	0,4 (±0,0)	5,0 (±0,3)	0,1 (±0,0)	0,1 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	0,0 (±0,0)	0,2 (±0,0)	5,9 (±0,3)
iBu	3	1,0 (±0,1)	1,6 (±0,1)	0,2 (±0,0)	1,0 (±0,1)	0,0 (±0,0)	1,5 (±0,1)	1,0 (±0,2)	0,2 (±0,0)	6,6 (±0,4)
FFV car										
Base	2	0,8 (±0,1)	0,6 (±1,7)	0,0 (±0,0)	0,0 (±0,4)	0,0 (±0,0)	0,1 (±0,7)	0,0 (±0,3)	0,2 (±0,0)	1,8 (±0,1)
E10	3	0,7 (±0,1)	3,5 (±0,2)	0,1 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	0,0 (±0,0)	0,3 (±0,0)	4,6 (±0,1)
E10+R	3	0,9 (±0,1)	3,6 (±0,1)	0,1 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,1 (±0,0)	0,0 (±0,0)	0,3 (±0,0)	5,0 (±0,2)
iBu	3	2,0 (±0,0)	1,1 (±0,1)	0,2 (±0,0)	1,0 (±0,1)	0,0 (±0,0)	3,5 (±0,3)	0,6 (±0,1)	0,4 (±0,0)	8,9 (±0,7)
E30	2	1,1 (±0,0)	13,0 (±1,0)	0,1 (±0,0)	0,0 (±0,0)	0,0 (±0,0)	0,2 (±0,0)	0,1 (±0,1)	0,2 (±0,0)	14,8 (±0,9)
E85	2	6,9 (±1,8)	99,3 (±9,0)	1,2 (±0,3)	0,8 (±0,1)	0,4 (±0,1)	0,3 (±0,1)	0,3 (±0,0)	0,3 (±0,1)	109,5 (±11,5)

[a]Number of data points. [b]Mean and standard deviation. Detection limit approximately 0.01 mg/km.

TABLE S5. Hydrocarbon emissions (mg/km).[b, c]

	No[a]	Met- hane	Ethane	Ethe- ne	Propa- ne	Prope- ne	Acety- lene	Isobu- tene	1,3- Butadie	Benze- ne	BTEX
MPFI car											
Base	2	7,8	2,7	14,2	0,3	8,0	3,5	3,9	1,0	7,9	125,2
		(±0,6)	(±0,0)	(±0,5)	(±0,0)	(±0,1)	(±0,3)	(±0,0)	(±0,0)	(±0,1)	(±0,3)
E10	1	6,8	2,1	14,1	0,00	6,7	2,6	2,5	1,1	8,7	123,2
E10+R	2	7,5	2,1	14,1	0,17	6,7	3,2	2,8	0,8	7,5	127,1
		(±0,3)	(±0,0)	(±0,1)	(±0,1)	(±0,1)	(±0,4)	(±0,0)	(±0,1)	(±0,1)	(±2,2)
iBu	4	6,3	2,5	12,2	0,33	11,2	2,8	4,1	2,0	7,7	114,6
		(±0,3)	(±0,2)	(±0,4)	(±0,1)	(±0,3)	(±0,3)	(±0,1)	(±0,6)	(±0,3)	(±9,1)
DISI car											
Base	2	21,7	5,5	35,7	0,53	15,5	10,2	7,0	2,1	20,6	170,0
		(±0,8)	(±0,6)	(±0,4)	(±0,0)	(±0,2)	(±1,2)	(±0,2)	(±0,1)	(±0,5)	(±2,8)
E10	3	18,1	4,7	32,9	0,52	12,4	10,4	4,4	1,8	19,6	158,6
		(±0,3)	(±0,1)	(±1,8)	(±0,1)	(±0,5)	(±1,5)	(±0,2)	(±0,2)	(±0,5)	(±4,2)
E10+R	2	19,8	4,6	34,5	0,74	13,8	12,6	5,4	1,6	20,3	178,4
		(±0,6)	(±0,4)	(±1,0)	(±0,2)	(±0,4)	(±0,6)	(±0,1)	(±0,0)	(±0,1)	(±2,1)
iBu	3	20,1	5,5	33,6	0,89	20,8	10,9	9,8	2,1	20,1	162,2
		(±1,0)	(±0,2)	(±1,8)	(±0,2)	(±1,4)	(±1,8)	(±0,1)	(±0,3)	(±1,0)	(±12,4)
FFV car											
Base	2	11,2	5,0	17,7	0,67	11,9	7,7	5,6	3,2	8,3	83,7
		(±1,0)	(±0,7)	(±1,1)	(±0,3)	(±3,6)	(±0,0)	(±1,6)	(±0,2)	(±1,3)	(±8,5)
E10	1	13,0	3,7	21,4	0,53	10,9	9,6	3,8	3,3	9,6	99,5
E10+R	1	14,0	4,0	20,5	0,26	10,4	7,2	3,8	2,1	9,4	99,6
iBu	3	13,1	5,2	21,9	0,44	16,7	9,9	6,8	3,3	10,0	105,9
		(±0,4)	(±0,1)	(±0,3)	(±0,1)	(±0,5)	(±1,0)	(±0,4)	(±0,2)	(±0,5)	(±9,1)
E30	1	21,1	4,8	25,1	0,35	12,7	14,9	8,9	2,3	9,7	94,8
E85	1	109,0	15,0	129,8	0,54	7,5	76,1	10,1	3,1	16,7	161,4

[a]Number of data points. [b]Mean and standard deviation. Detection limit is approximately 0.5 mg/km for 1,3-butadiene, 0.7 mg/km for benzene and 0.1 mg/km for methane.

TABLE S6. Alcohols, ETBE and nitrogen-containing emissions (mg/km).[b]

	No[a]	Ethanol	i-Butanol	ETBE	NO_2	N_2O	NH_3
MPFI car							
Base	2	<7	<7	<7	<4	<4	24,0 (±0,1)
E10	2	18,4 (±0,1)	<7	<7	5,5 (±0,2)	5,5 (±0,2)	21,9 (±1,4)
E10+R	3	18,3 (±1,2)	<7	<7	<4	<4	18,0 (±0,2)
iBu	3	<7	36,8 (±1,3)	<7	6,5 (±1,0)	6,5 (±1,0)	18,9 (±0,8)
DISI car							
Base	2	<7	<7	<7	<4	<4	21,2 (±2,5)
E10	2	13,7 (±0,5)	<7	<7	4,7 (±0,7)	4,7 (±0,7)	15,5 (±2,4)
E10+R	3	16,7 (±1,5)	<7	<7	4,0 (±0,2)	4,0 (±0,2)	19,8 (±1,5)
iBu	3	<7	46,8 (±7,4)	<7	<4	<4	5,1 (±2,7)
FFV car							
Base	2	<7	<7	<7	5,9 (±0,1)	5,9 (±0,1)	5,6 (±0,0)
E10	3	11,3 (±1,1)	<7	<7	6,5 (±0,5)	6,5 (±0,5)	5,0 (±0,5)
E10+R	3	10,6 (±1,2)	<7	<7	4,9 (±0,4)	4,9 (±0,4)	7,9 (±1,4)
iBu	2	<7	29,3 (±2,8)	<7	7,2 (±1,7)	7,2 (±1,7)	6,5 (±0,5)
E30	2	93,6 (±1,5)	<7	<7	5,6 (±0,6)	5,6 (±0,6)	5,4 (±0,5)
E85	2	2539,2 (±359,1)	45,6 (±6,4)	58,9 (±4,1)	11,4 (±2,5)	11,4 (±2,5)	39,0 (±2,7)

[a]Number of data points. [b]Mean and standard deviation. Detection limit appr. 7-9 mg/km for ethanol, isobutanol and ETBE, 4 mg/km for NO_2 and N_2O and 1 mg/km for NH_3.

TABLE S7. PAH emissions (µg/km).[b]										
	No[a]	Benz[a]anthr	DMBA	Chrys ene	Benzo[b]fluorant	Benzo[k]fluor	Benzo[a]pyrene	Indeno[1,2,3-	BaPeq	PAH7
MPFI car										
Base	1	1,1	0,3	0,5	1,2	0,4	1,2	0,6	2,9	5,2
E10	1	1,4	0,2	0,8	1,5	0,4	1,6	0,9	4,0	6,7
E10+R	1	1,3	0,2	0,7	1,9	0,5	2,0	0,9	4,2	7,5
iBu	1	2,1	0,3	1,3	2,6	0,7	2,4	1,0	6,6	10,4
DISI car										
Base	2	16,1 (±0,2)	0,4 (±0,4)	9,2 (±0,2)	22,3 (±0,6)	6,1 (±0,3)	20,4 (±0,3)	11,5 (±0,9)	47,8 (±1,3)	86,0 (±1,7)
E10	2	11,1 (±1,0)	0,7 (±0,1)	6,6 (±0,8)	17,0 (±1,9)	5,0 (±0,4)	14,1 (±0,6)	8,9 (±1,3)	34,9 (±3,0)	63,3 (±5,1)
E10+R	2	11,4 (±1,5)	0,7 (±0,0)	6,7 (±0,7)	18,0 (±2,6)	4,7 (±0,5)	14,7 (±1,2)	8,4 (±0,8)	35,8 (±3,8)	64,8 (±7,3)
iBu	2	10,2 (±0,7)	0,6 (±0,0)	5,8 (±0,3)	15,1 (±1,1)	4,0 (±0,3)	13,4 (±1,6)	8,4 (±0,3)	32,1 (±2,7)	57,4 (±4,2)
FFV car										
Base	0									
E10	1	1,7	0,0	0,9	2,3	0,6	1,9	0,9	4,9	8,4
E10+R	1	2,3	0,0	1,3	3,1	0,8	2,5	1,3	6,4	11,4
iBu	1	2,7	0,0	1,4	3,4	1,0	3,0	1,3	7,3	12,9
E30	1	2,2	0,0	1,1	2,5	0,7	2,6	1,4	6,1	10,5
E85	1	2,7	0,7	1,4	4,0	1,1	7,0	2,9	13,5	19,8

[a]Number of data points. [b]Mean and standard deviation. Detection limit appr. 0.04 µg/km for MPFI and 0.08 µg/km for DISI and FFV.

TABLE S8. Average percentage changes in emissions between fuels over the European test cycle at -7 °C.

		CO	HC	NO_x	PM	Formaldehyde	Acetaldehyde	Sum aldehyde (11)	Ethanol	i-Butanol	Sum alcohols	Methane	Ethene	Propene	Acetylene	i-Butene	1,3-Butadiene	BTEX	PAH7
<u>Low-level oxygenates compared with Base</u>																			
E10	FFV	5 %	6 %	-6 %	-7 %	-5 %	460 %	163 %	9824 %	bd	693 %	16 %	21 %	-8 %	25 %	-32 %	4 %	19 %	
E10+R	FFV	4 %	17 %	-18 %	14 %	19 %	484 %	184 %	9134 %	bd	675 %	26 %	16 %	-13 %	-6 %	-32 %	-36 %	19 %	[a]
iBu	FFV	4 %	31 %	-23 %	34 %	165 %	77 %	404 %	bd	1437 %	1190 %	17 %	24 %	41 %	28 %	23 %	2 %	27 %	[a]
E10	DISI	-21 %	-11 %	11 %	-16 %	34 %	372 %	236 %	35514 %	bd	271 %	-17 %	-8 %	-20 %	1 %	-37 %	-16 %	-7 %	-26 %
E10+R	DISI	-30 %	-7 %	33 %	-5 %	23 %	366 %	221 %	43332 %	bd	347 %	-9 %	-3 %	-11 %	23 %	-23 %	-25 %	5 %	-25 %
iBu	DISI	-25 %	-6 %	11 %	-10 %	242 %	53 %	262 %	bd	790 %	681 %	-8 %	-6 %	34 %	7 %	40 %	-1 %	-5 %	-33 %
E10	MPFI	-19 %	-2 %	33 %	41 %	41 %	616 %	380 %	2571 %	bd	350 %	-12 %	-1 %	-17 %	-25 %	-37 %	10 %	-2 %	28 %
E10+R	MPFI	-14 %	1 %	24 %	15 %	38 %	618 %	376 %	2554 %	bd	358 %	-4 %	-1 %	-17 %	-9 %	-29 %	-20 %	2 %	43 %
iBu	MPFI	-35 %	-4 %	48 %	110 %	162 %	13 %	852 %	bd	882 %	582 %	-19 %	-14 %	39 %	-20 %	5 %	95 %	-8 %	99 %
<u>E10+R compared with E10</u>																			
E10+R	FFV	-1 %	10 %	-13 %	23 %	26 %	4 %	8 %	-7 %	bd	-2 %	8 %	-4 %	-5 %	-25 %	0 %	-38 %	0 %	36 %
E10+R	DISI	-11 %	5 %	20 %	13 %	-8 %	-1 %	-4 %	22 %	bd	21 %	9 %	5 %	12 %	21 %	23 %	-10 %	12 %	2 %
E10+R	MPFI	4 %	3 %	-1 %	-13 %	2 %	0 %	0 %	1 %	bd	3 %	6 %	0 %	0 %	13 %	8 %	-20 %	2 %	12 %
<u>E85 and E30 compared with Base</u>																			
E85	FFV	151 %	766 %	-52 %	118 %	802 %	15812 %	6130 %	2222054 %	2291 %	112827 %	875 %	635 %	-37 %	892 %	82 %	-2 %	93 %	[a]
E30	FFV	46 %	52 %	-36 %	13 %	47 %	1984 %	740 %	81851 %	bd	4465 %	88 %	42 %	7 %	94 %	60 %	-29 %	13 %	[a]

[a] Result with Base is missing for FFV. Compared with E10, for E85 +136% and for E30 +26%. Bd = Below detection limit.

TABLE S9. *p*-Values calculated with two-sample t-test assuming equal variances. *p*-values ≤ 0.05 indicates that mean values for fuels are different with 95% confidence interval (bold).

		CO	HC	NO_x	PM	Formaldehyde	Acetaldehyde	Sum aldehyde (11)	Ethanol	i-Butanol	Sum alcohols	Methane	Ethene	Propene	Acetylene	i-Butene	1,3-Butadiene	BTEX	PAH7
<u>Low-level oxygenates compared with Base</u>																			
E10	FFV	0,43	0,56	**0,02**	0,64	0,78	**0,00**	**0,00**	**0,00**	bd	**0,00**	**0,05**	**0,04**	0,33	**0,00**	**0,03**	0,38	0,09	[a]
E10+R	FFV	0,67	0,08	**0,04**	0,41	0,24	**0,00**	**0,00**	**0,00**	bd	**0,00**	**0,01**	0,07	0,17	0,07	**0,03**	**0,00**	0,08	[a]
iBu	FFV	0,41	0,07	0,12	0,14	**0,00**	**0,01**	**0,00**	bd	**0,00**	**0,00**	0,06	**0,03**	**0,02**	0,09	0,11	0,77	0,12	[a]
E10	DISI	**0,01**	**0,05**	**0,05**	**0,03**	0,08	**0,00**	**0,00**	**0,00**	bd	**0,00**	**0,01**	0,19	**0,01**	0,94	**0,00**	0,17	0,08	0,05
E10+R	DISI	**0,00**	0,07	0,06	0,66	0,09	**0,00**	**0,00**	**0,00**	bd	**0,00**	0,19	0,38	0,05	0,22	**0,02**	**0,03**	0,14	0,11
iBu	DISI	**0,00**	0,47	**0,04**	0,15	**0,01**	**0,00**	**0,00**	bd	**0,01**	**0,01**	0,23	0,30	**0,02**	0,74	**0,00**	0,94	0,55	**0,02**
E10	MPFI	0,09	0,60	0,12	0,07	**0,03**	**0,01**	**0,01**	**0,00**	bd	**0,00**	0,24	0,74	**0,00**	0,07	**0,00**	0,10	**0,02**	[a]
E10+R	MPFI	0,06	0,69	0,22	**0,05**	**0,04**	**0,00**	**0,00**	**0,00**	bd	**0,00**	0,61	0,79	**0,00**	0,50	**0,00**	0,06	0,41	[a]
iBu	MPFI	**0,01**	0,56	**0,04**	0,26	**0,01**	0,41	**0,00**	bd	**0,00**	**0,00**	**0,02**	**0,01**	**0,00**	0,08	0,17	0,16	0,25	[a]
<u>E10+R compared with E10</u>																			
E10+R	FFV	0,92	0,16	**0,05**	**0,01**	0,22	0,25	0,06	0,54	bd	0,79	[a]	[a]	[a]	[a]	[a]	[a]	[a]	[a]
E10+R	DISI	0,07	0,21	0,07	0,28	0,29	0,90	0,60	0,05	bd	**0,01**	**0,05**	0,45	0,07	0,22	**0,01**	0,39	**0,02**	0,89
E10+R	MPFI	**0,03**	0,46	0,58	0,07	0,85	0,95	0,88	0,92	bd	0,71	0,09	0,47	0,82	0,20	**0,00**	**0,02**	0,14	[a]
<u>E85 and E30 compared with Base</u>																			
E85	FFV	**0,01**	**0,01**	**0,01**	**0,02**	0,08	**0,01**	**0,01**	**0,02**	**0,02**	**0,02**	**0,00**	**0,00**	0,06	**0,00**	**0,02**	0,73	**0,01**	[a]
E30	FFV	**0,03**	**0,03**	**0,00**	0,57	**0,02**	**0,01**	**0,00**	**0,00**	bd	**0,00**	**0,01**	**0,03**	0,52	**0,00**	**0,03**	**0,03**	0,32	[a]

[a] Missing replicate tests.