The Effect of Cumin (*Cuminum cyminum*) Addition as Source of Essential Oils on Nutrien Digestibility, VFA, Amonia and Methan Production

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ABSTRACT

In vitro gas production technique was used to evaluate the effects of different doses of cumin (*Cuminum cyminum*) on rumen in vitro nutrient digestibility, VFA, ammonia and methane production. Addition of cumin correspond to essential oil levels of 0, 25, 50, 75 and 100 mg/L of fermentation medium, Fermentation was conducted according to Menke and Steingab methode for 24h. After 24 h, incubation was stopped and gas produced in each fermenter were collected to measured methane production, then fermentation broth was filtered to determine nutrient digestibility from the residual feed. Filtrate was used as sample for VFA and ammonia determination. Addition of cumin did not has detrimental effect on rumen fermentation. It did not alter pH, dry matter and organic matter digestibility, VFA and methane production. However ammonia concentration, crude protein and crude fiber digestibility were changed by cumin addition. Crude protein digestibility at cumin level 75 and 100 mg/L lower than control and cumin levels 25, 50 mg/L groups. Ammonia concentration reduced as effect of cumin addition. Crude fiber digestibility was higher at all level of cumin addition. In conclusion, cumin have capability to alter rumen fermentation and it has been potency to be used as additive.

Keywords: Cumin, Essential oil, Digestibility, Methane, Fermentation.

INTRODUCTION

Feed digestion in rumen, basically is combination between physical digestion during chewing and fermentation by ruminal microbe (Hart et al, 2008). Changes composition and number of rumen microbe by modified rumen environment might effective to increase feed digestion efficiency (Szumacher-Strabel, 2012). Several compounds have been used as rumen microbial modifier with the main goal is increase feed efficiency and reduce methane emission. Those compounds for instant antibiotic, ionophores, and inhibitors methane production (Patra and Saxena, 2009). Recently utilization of those chemical compounds was banned in several country do to consumers safety and researches to seek alternative and saver rumen modifier has being intensively done. Essential oils (EOs}, is one of promising candidate to be explored as feed additives for animals. Antimicrobial properties of EO is the importance point to modify the growth rumen microbe as antibiotic substitute, even in different mode of action.

Hydrophobicity of EOs caused accumulation of this component in the bacterial lipid bilayer membrane, and changes cell wall membrane conformation and permeability (Dormans and Deans, 2000). Alternate mechanism particularly for low molecular weight compounds, they permeate through cell membrane molecule and diffused into the cell and interfere cell mechanism (Szumacher-Strabel, 2012).

EOs biological activity is depend on several factors such as, plant origin, EOs bioactive component and the doses of EOs being used (Macheboeuf et al., 2008; Kozelov et al., 2001; Castillejos et al., 2006, 2007). Effect of EOs nutrient digestibility and rumen metabolism are varies, *thymol* addition in level in 2.2 mg/L reduced methane emission, however, increasing level to 300 mg/L reduced not only methane but also feed efficiency, dry matter digestibility and crude fiber digestibility (Wallace, 2004; Benchaar and Greathead, 2011). Whereas *eugenol* addition did not affect dry matter digestibility and crude fiber digestibility (Calsamiglia et al., 2007; Castillejos et al., 2006).

Cumin (***Cuminum cyminum***) in Indonesia commonly used as component of traditional medicine or spices. Identified EOs component of cumin was 18 item that including to monoterpene hydrocarbons 48.05%, oxygenated monoterpenes 51.27% and sesquiterpene hydrocarbons 0.66%. The main constituents of the oil were terpinen-7-al 23.75%, terpinene 23.72%, cuminic aldehyde 19.13%, pinene 16.23%, terpinen-7-al 8.24% and p-cymene 6.35% (Ghafari et al, 2015).

MATERIAL AN D METHOD

Feed materials

Cumin as essential oil source in this research was obtained from herb shop at traditional market of Bringharjo, Yogyakarta. Cumin was dried in incubator dryer at 55ºC and grinded to pass of 2 mesh of sieves. Diet for fermentation substrate consist of *Pennisetum purpureum* (cut before flowering stage), rice bran and wheat pollard (obtained from feed shop), in ratio 60:20:20 based on dry matter.

In vitro fermentation.

In vitro feed fermentation was done by modified of Theodorou (2004) method. Modification was done in total volume of fermentation. In Theodurou method used 150 ml of serum bottle whereas in this research using 125 ml serum bottle. Volume of sample, buffered medium and rumen liquor were adjusted by scale down to get the same ratio of medium volume and head space. Fermentation was conducting for 24h. Gas for methane analysis was tahen at the end of incubation. Residual feed and broth sample were collected at the end of incubation by filtration. Residual feed than be analyzed for DM, OM, CP and CF content for digestibility calculation. Ammonia and VFA were measured from the filtrate.

Data Analysis.

Collected data were analyzed by analysis of variance using one way design, followed by DMRT.

RESULT AND DISCUSSION

Addition of cumin in the diet reduced crude protein digestibility at cumin level equal to EOs concentration of 75 and 100 mg/L (Table 1) ($P<0.01$). This result in agreement with Tager and Krause, (2010), crude protein digestibility and bacterial nitrogen flow was depressed with cinnamaldehyde and eugenol (500mg/l/d). In this study the decreasing of CPD did not followed by decreasing of ammonia concentration (Table 2). Cardozo et al, (2005) showed level of EOs has significant effect in CPD and ammonia concentration, Eugenol at low level (0.3 and 3 mg/l) tend to increase ammonia, at 30 mg/l (moderate level) have no effect but at high level (300, 3000 and 5000 mg/l) significantly reduced ammonia batch culture. Addition trans-cinnamaldehyde and cinnamon EO resulted in largest decrease in ammonia concentrations (Macheboeuf et al., 2008)

Dry matter digestibility and organic matter digestibility were not affected by cumin addition (Table 1.). Cumin addition up to level 100 mg/l have not negative effect on fermentation. Even the percentage of digested DM and OM did not changed by cumin addition but the digested of DM and OM increased in line with increasing of cumin addition (data are not shown). Total DM and OM in the fermenter increased as consequence of addition of cumin as EOs source in raw material and microbe in the fermenter capable to degrade them. Cumin contain DM 91.20% and OM 92.11%. Other study, Khan and Chaudhry, (2010) showed addition cumin in low level (10 to 90 mg/g equal to 3 to 27mg/l in this study) increased DMD and DOMD. This different finding might be caused by different level of cumin and also differences of feed composition. Substrate used in Khan and Chaudhry, (2010) research were low quality feed for instant rice straw, wheat straw and rye grass hay wherease in this research used forage and concentrate. Kilic et al. (2011) recommended that cumin could be consider as feed additive and may be used to improve cellulose digestion, that why cumin improved degradability of low quality feed material that have higher fiber content. Those recomendation was strenghtened by finding in this research that CF digestibility increased by increased of cumin addition (P<0.01).

Table 1. Nutrient digestibility of in vitro fermentation with addition of cumin as essential oils source

Treatment	Essential oil level (mg/L)				
	0	25	50	75	100
Dry matter digestibility (%)	51.33 ±4.643	49.89 ±1.602	43.22 ±2.945	44.28 ±5.204	44.47 ±5.660
Organic matter digestibility (%)	46.64 ±2.984	48.25 ±0.754	54.48 ±1.627	52.86 ±3.855	52.33 ±4.586
Crude protein digestibility (%)**	61.50[a] ±3.150	63.24[a] ±1.011	67.01[a] ±5.175	44.31[b] ±2.609	48.84[b] ±0.286
Crude fiber digestibility (%)**	30.95[c] ±0.541	35.44[b] ±1.726	38.19[ab] ±1.917	36.64[b] ±1.759	41.03[a] ±1.528

Table 2. Methane production, VFA and ammonia concentration of in vitro fermentation with addition of cumin as essential oils source

Treatment	Essential oil level (mg/L)				
	0	25	50	75	100
Methane production/g digested DM	39.53 ±3.526	43.74 ±0.510	38.35 ±0.799	35.70 ±6.162	36.06 ±1.678
total VFA production mMol	30.95 ±6.803	27.89 ±3.434	23.43 ±2.283	19.16 ±4.325	24.49 ±4.853
Ammonia concentration (mg/100ml)	23.81 ±0.050	25.60 ±0.050	26.65 ±0.328	24.76 ±0.883	26.77 ±0.051

Volatile fatty acid did not affected by the treatment (table 2), might due to low level of EOs in cumin addition as well as might in consequence of unchanged of DM and OM digestibility. EO in high level, Cinamaldehyde reduced VFA and its component at level 3000 mg/L and up (Busquet et al., 2006), 300 mg/L up to 660 mg/L (Macheboeuf et al., 2008) except acetate did not affected.

Several essential oil component reduced methane at different level, carvacrol at 225mg/L, cinnamaldehyde at 265 mg/L, and thymol at 300mg/L (Macheboeuf et al., 2008). In this research addition of cumin which equal to EO levels 25 to 100 mg/L did not change methane production as shown in Table 2. In many studies, the effective doses of EO able to affectammonia production are lower than that needed to affect methane production (Macheboeuf et al., 2008; Lin et al., 2012; Patra and Yu, 2012).

CONCLUSION

Cumin at level equal to EOs concentration 25 to 100 mg/L could be used as feed additive that can increased feed efficiency by increasing crude fiber digestibility and decrease crude protein degradation

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