Research Article
J. Food Sci. Technol. Nepal, Vol. 14 (19-28), 2024
ISSN : 1816-0727

Preparation and Quality Evaluation of "Timur Raksi", an Indigenous Alcoholic Beverage of Rolpa ,Nepal

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Abstract

The Timur raksi is an indigenous distilled alcoholic beverage made in Rolpa, Nepal. The study aimed to formulate timur raksi in the lab using various timur ratios, analyze chemical changes (pH, TSS, reducing sugar) during fermentation, evaluate chemical and sensory attributes of the final product, and assess yield and cost. The survey collected sample R1 from Rolpa. Rice and manapu were used for the first fermentation, while mana and jaggery were used for the second. Raksi samples R2, R3, and R4 were prepared using 50g, 75g, and 100g of timur, respectively. The proximate analyses of rice, jaggery, and timur were done. Reducing sugar, pH, and TSS were measured every 7 days throughout fermentation. The ethanol concentration of five distillate cycles (1 pani, 2 pani, 3 pani, 4 pani, and 5 pani) was determined. Total acidity was analyzed for final product. Propyl alcohol, ethyl acetate, isobutanol, acetal, fusel oil, acytol, linalol, ethyl palmitate, and D-limonene were the components discovered in samples R1, R2, R3, and R4 by GC-MS. The total yields of samples R2, R3, and R4 were 88.49%, 88%, and 87.53%, respectively. It can be concluded that on the basis of sensory evaluation, R3 was found to be the most preferable. The cost of the best product (R3) obtained was reasonably priced compared to market whiskey.

Keywords: *Alcoholic beverage, Timur, Fermentation, Distillation, Ethanol*

INTRODUCTION

Timur rakshi is an ethnic alcoholic beverage produced in Rolpa District, Nepal, it is a locally fermented and distilled drink made from fermented mash slurry. Consumed daily by Rolpa's ethnic groups, according to survey, traditionally, *murcha* is used as a beginning culture in the preparation of *raksi*, as it is in the preparation of *jand*, and then it is distilled by adding *timur* in the fermented mash to make *timur raksi*. It's commonly produced due to *timur'*s popularity (MOAD, 2022), Surveys reveal 25% produce it for income, 50% rely on it despite drawbacks, and 85% of females are involved in its production. Various ethnic communities use different methods, generating significant income.

In Nepal, Taichung-176 (TR) rice (Bhaba et al., 2019) is widely used for both meals and fermentation (Poudel et al., 2017). It is chosen for its availability and affordability. *Timur* (*Zanthoxylum piperitum*), or Sichuan pepper, contains pungent hydroxy-sanshool compounds, which may vary the intensity on mildness after distillation (Bhatt et al., 2017; Chi et al., 2021). *Murcha* (two types: *manapu* and *mana*), a traditional Nepali amylolytic starter culture, aids in making indigenous alcoholic beverages and includes filamentous molds, yeasts, and bacteria for starch and protein digestion (Tamang et al., 1988; Tsuyoshi et al., 2005). *Jaggery*, a low-cost sugarcane sweetener, enhances fermentation due to its trace minerals and vitamins (Gakkhar et al., 2013; Osman, 2011).

Sichuan pepper is used in cocktails and vodka (Kelly et al., 2017). In Nepal, new products like timur-flavored beer and *Khukri* spiced rum have emerged (Anonymous, 2021). Research on traditional distillation and *raksi* characteristics is limited. This study surveys *timur raksi*, distills fermented mash with varying *timur* concentrations, and analyzes the resulting beverages for nutritional, physicochemical, statistical, sensory, and phytochemical properties using rice, *jaggery*, and *murcha*.

In Rolpa, *timur raksi* is a common drink, but lacks commercialization and branding. Despite its popularity, its chemical analysis and product quality were not studied. This research aims to optimize and evaluate the drinkability of *timur raksi*, potentially introducing new flavors to alcoholic beverages. Improving branding and quality could encourage household women who produce *raksi* and *murcha*, enhancing their economic status. The study will focus on product diversification, benefiting distillery industries and consumer

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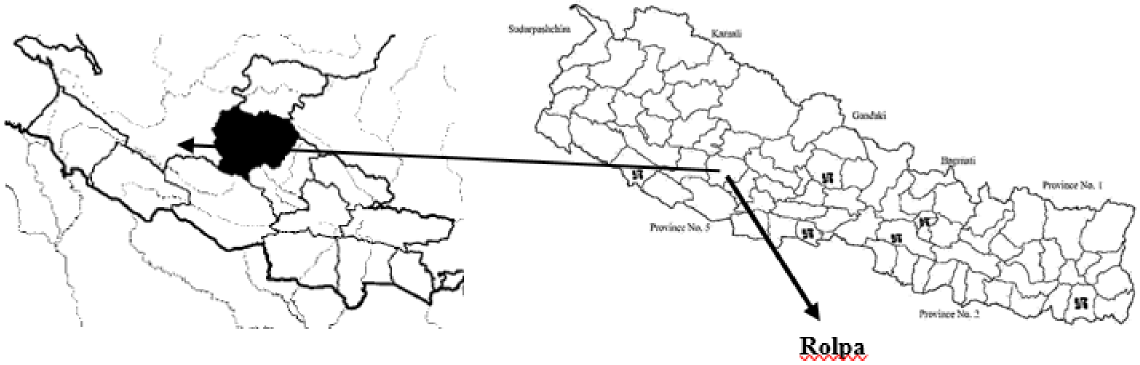

Figure 1: Survey and timur sample collection site (Lumbini Province Nepal)

Source: Boudha et al. (2020)

MATERIALS AND METHODS

Survey and Sample collection

A survey collected data on the definition, history, quality, production, and marketing of *timur raksi* in Rolpa using a questionnaire. Respondents included home producers and traders selling *raksi* in restaurants and shops. A semi-structured questionnaire was used, and 15 respondents were selected with key informant consultation.

Raw materials

Locally available Taichung-176 rice, *murcha* (*manapu* and *mana*), and jaggery were purchased in Kathmandu. Dry *timur* (*Zanthoxylum piperitum*) was sourced from Rolpa's farming land (3200 m above sea level).

Table 1: Respondent Profile

Demographics	Total
Age Group	
20-40	4
40-60	8
60-80	2
Gender	
Male	5
Female	10
Cast/Tribe	
Chhetri	3
Gurung	3
Magar	7
Newar	2

*Number of respondents=15

Calculation of ingredients

Rice provided starch, *jaggery* as an adjunct, and *murcha* as a starter for fermentation. *Timur* was added during distillation. The recipe was adjusted based on the survey, incorporating *jaggery* and *mana* in the second fermentation. Three ditillates were prepared with 50 g, 75 g and 100 g of *timur* per mash. Control sample R_1 was purchased from Rolpa market. Ingredient amounts are listed in Table 2.

Table 2: List of Ingredients

Raw Ingredients	R_2	R_3	R_4
Rice (*Taichung*)(kg)	3	3	3
Murcha(*manapu*)(g)	20	20	20
Jaggery(kg)	1.25	1.25	1.25
Murcha(*mana*)(g)	200	200	200
Timur(g)	50	75	100

Preparation of fermented mash

Three kilograms of rice (Oryza sativa) for R2, R3, and R4 were winnowed, washed thrice, cooked, and air-cooled. *Murcha (manapu)* powder (20g in 3kg rice) was mixed into the cooled rice to make a mash, which was then transferred to 500 ml fermentation jars. Covered with muslin cloth, the jars were left at room temperature for 2 days. Fermented odor indicated peak biomass after 48 hours.

First stage fermentation (F1)

After 48 hours, inoculated mashes were transferred to sealed plastic jars for solid-state fermentation, named R_2, R_3, and R_4. Chemical analysis (reducing sugar, pH, TSS) was performed every 7 days. The first-stage fermentation lasted 15 days and was labeled F1.

Second stage fermentation (F_2)

After the first fermentation, 1.25 kg of *jaggery* and 200g of *murcha* (*mana*) were added to jars R_2, R_3, and R_4 for a second fermentation lasting 35 days. Chemical changes (reducing sugar, pH, TSS) were analyzed weekly. After 35 days, the mash was ready for distillation. The second stage fermented was coded as F_2. Here, F_1 refers first stage fermentation (fermented mash before added *jaggery* and *manapu*), and F_2 refers second stage fermentation (fermented mash after added *jaggery* and *mana*).

Distillation (Preparation of *Timur raksi*)

By modifying the fermentation period from the questionnaire, the fermented mash was ready for distillation after 35 days of alcoholic fermentation.

The fermented masses of jars R_2, R_3, and R_4 were heated with 50g, 75g, and 100g *timur*, respectively, for distillation using a traditional method (Ghosh et al., 2016) with local modifications. The first 20 ml of distillate was discarded to reduce toxins. The cold water pot was refilled five times, and distillates were collected. Five distillates (1-5) were obtained from each mash and stored separately, each with different alcohol yields.

For sensory evaluation, each cycles (pane) 1, 2, 3, and 4 were mixed to achieve a 40% (v\v) alcohol concentration, resulting in *timur raksi* R_2, R_3, and R_4. Distillate 5 was excluded due to its acidic taste and lack of flavor. 50% of respondents recommended avoiding the 5^{th} pane for better results.

Proximate analysis of raw material

As per AOAC (2019), the protein content, crude fat, crude fiber, moisture content, total ash and carbohydrate content of rice, *jaggery* and *timur* was determined.

Chemical analysis of fermented mash and final product (*timur raksi*)

Total soluble solids of fermented mash F_1 and F_2 were measured using an Abbe refractometer, and pH was measured with a pH meter (AOAC, 2019). Reducing sugar, total acidity, and alcohol content were evaluated per FSSAI (2021). GC-MS analysis (GCMS-QP2010 Plus, Shimadzu, Japan) assessed esters, aldehydes, furfural, methanol, higher alcohols, terpenes, and fusel oil. The system used a DB-5 capillary column (0.25 µm film, 0.25 mm ID, 30 m length) with a 20:1 split injection of 1 µl sample, at 260°C injection and 270°C interface temperatures. Helium (99.9%) served as the carrier gas. The flow rates were 16.3 ml/min total and 1.21 ml/min column. Mass spectra were recorded at 5 scans/s from 40-650 m/z, and compounds were identified by comparing spectra with the NIST08s.LIB database. Quantification was based on peak areas in the chromatogram.

Sensory analysis

Sensory evaluation of *timur raksi* used a hedonic rating test (AOAC, 2019) for color, odor, flavor, texture, and overall acceptance. Fifteen panelists, including staff, faculty, and students, rated samples R_1 (control), R_2 (50g *timur*), R_3 (75g *timur*), and R_4 (100g *timur*), with the control purchased from Rolpa.

Statistical analysis

Triplicates of each sample were analyzed for constituents. Data on raw materials, sensory quality, and physicochemical properties (pH, reducing sugar, TSS) were tested for significance at 5% using one-way ANOVA in SPSS Statistics 16. Statistical calculations and bar graphs were created in Microsoft Office Excel 2010.

RESULTS AND DISCUSSIONS

Survey findings

Table A shows the respondent profile. 10% have their own *timur* farms and can sell to Kathmandu. 90% use rice for fermentation, with *mota chamal* and *taichin* used in Rolpa. 65% said fermentation before adding *jaggery* and *murcha* takes 15 days in summer and up to 25 days in winter. Budha (2022) detailed the fermentation process. 75% produce 3 pane *raksi*, and all agree on the need for experienced makers. 5% recommended adding 20-100g *timur*.

Sellers are satisfied with strong local demand and plan to expand, with monthly incomes of NRs. 20,000 to 25,000. Some produce *raksi* for personal use. Prices vary with ethanol concentration, and methods differ based on experience, with older individuals, especially women, being more experienced.

Proximate Composition of Raw Materials

The proximate compositions of rice, *jaggery*, and *timur* were analyzed on a wet basis, as shown in Tables 3. The results align closely with Pakuwal et al. (2021), showing similar protein and ash content in *taichin* rice but slightly lower moisture and carbohydrate levels compared to DFTQC (2017). Differences may arise from rice variety, storage, and conditions. *Jaggery* had lower reducing sugar and protein but higher moisture and ash than Barad et al. (2021) due to atmospheric moisture absorption. Moisture, carbohydrate, and ash content matched DFTQC (2017). In *timur*, Fat (6.24%) and ash (8.23%) were similar, but moisture was lower than DFTQC (2017), reason may be due to *timur* variety differences.

Table 3: Proximate composition of rice, Jaggery and Timur

Parameters	Rice	Jaggery	Timur
Moisture Content	11.95±0.21	8.82±0.68	11.42±0.33
Crude Fat	1.65±0.05	1.25±0.61	6.38±0.68
Crude Fiber	4.03±0.45	-	0.36±0.18
Total Ash	0.66±0.04	2.02±0.06	7.29±1.17
Crude Protein	6.85±0.33	0.36±0.06	0.11±0.10
Carbohydrate	74.85±0.62	87.55±1.08	74.44±1.34
Reducing sugar as dextrose	1.69±0.01	9.99±0.84	-

Chemical analysis of fermented mash

Changes in reducing sugars

Variation in reducing sugars of the fermented mash is shown in Fig. 4

Initially, reducing sugars were very low (1.60±0.05%). Reducing sugar was low before fermentation, adding *jaggery* and *mana* caused a sharp increase by day 21 of secondary fermentation, then decreased, likely due to mold hydrolysis and yeast fermentation. The decrease in reducing sugar was due to yeast converting sugars to alcohol. Fermented rice reducing sugar ranged from 0.36-0.74 mg/mL (Ghosh et al., 2016), The similar result was obtained by Shrestha *et al.* (2002) (reduced from 0.4% to 0%) and Khadka (2018), where the reducing sugar increased rapidly upto 6th day of fermentation and again decreased.

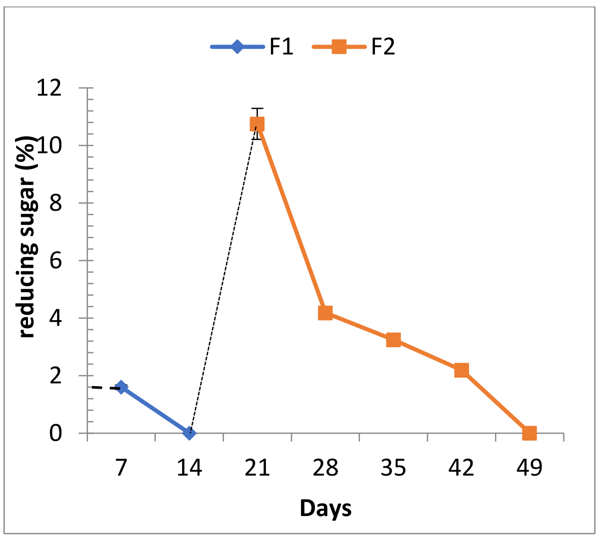

Fig 4 Changes in reducing sugar during different stages of fermentation

*F_1= first stage fermentation (Before added *jaggery* and *mana*)

*F_2= second stage fermentation (After added *jaggery* and *mana*)

Changes in TSS

Variation in reducing sugars of the fermented mash is shown in Fig. 5

Initially, the TSS of the fermented mash was 14.13±0.15ºBx on day 7. After adding *jaggery* and *murcha* on day 15, it decreased to 15.13±0.15ºBx by day 28, with similar values at days 42 and 49. Khadka (2018) and Dahal et al. (2007) reported final TSS values of 7ºBx in *jand* and *hyan thon*. TSS increases due to starch saccharification and decreases as yeasts ferment sugars. The higher TSS (11.12%) observed may be due to rice variety, adjuncts, and fermentation conditions.

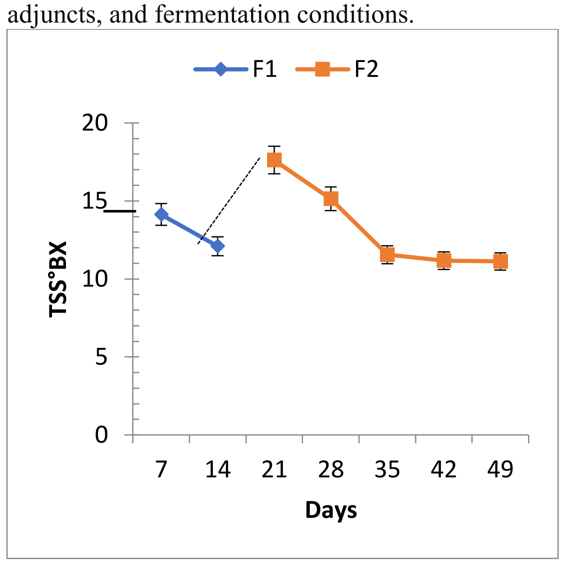

Figure 5 Changes in TSS of fermented mash in different stages of fermentation

*F_1= first stage fermentation (Before added *jaggery* and *mana*)

*F_2= second stage fermentation (After added *jaggery* and *mana*)

Changes in pH

Variation in pH of fermented mash is shown in Fig. 6.The highest pH was recorded on day 7 of F_1 and day 21 of F_2. Khadka (2018) noted yeast grows best at pH 4.5 to 5.5, and Casida (2016) attributed pH decrease to reduced enzymatic activity. The pH values are similar to Karki et al. (2011) (pH=3.9), Ray et al. (2016) (pH=3.58-3.66), and Shrestha et al. (2002) (pH=4.3-3.1), indicating consistency with other studies.

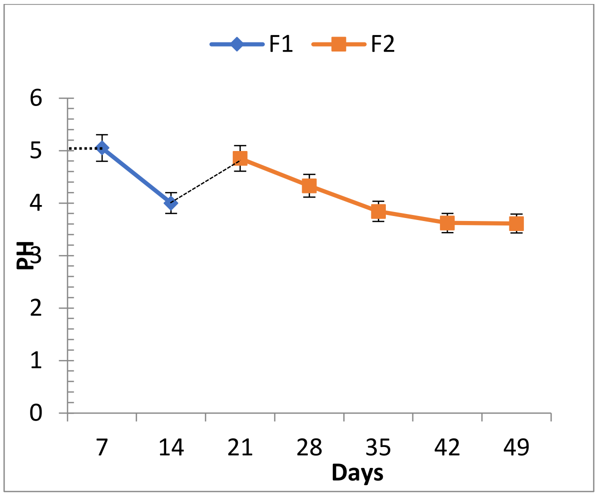

Figure 6 Change in pH of fermented mash during different stages of fermentation

*F_1= first stage fermentation (Before added *jaggery* and *mana*)

*F_2= second stage fermentation (After added *jaggery* and *mana*)

Chemical analysis of prepared *Raksi*

Effect on total acidity (as Lactic acid)

Variation in the total acidity of the fermented mash is shown in Fig. 7. There is no statistically significant difference between samples R_2, R_3 and R_4. Our results are in agreement with the values (0.24% m/v) reported by Karki *et al.* (2011). Comparing with the value (1.3%) reported by Manandhar (2020), very low value was obtained this may be because of incomplete fermentation. Saurav *et al.* (2017), stated the value may be lower for traditional *murcha* due to inconsistency in the quality of *murcha* as it contains various molds, yeast and bacteria.

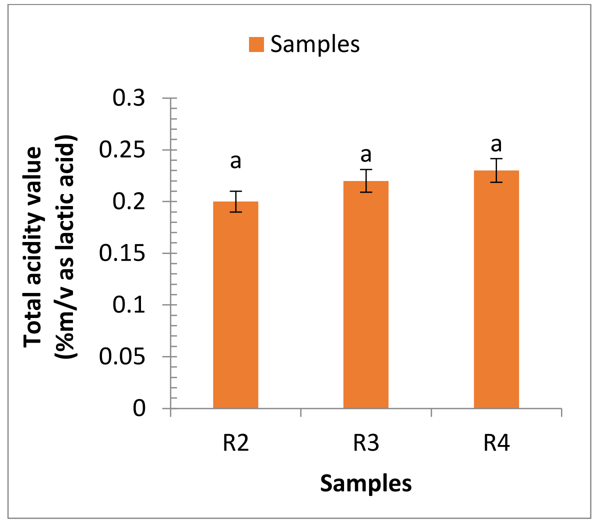

Figure 7 Effect of fermentation on the total acidity of Timur raksi

Bars having similar alphabets (a,b,c) are not statistically significant different by LSD at p>0.05

*Samples were coded R_2, R_3, and R_4 denoting *timur raksi* (50g *timur* added), *timur raksi* (75g *timur* added) and *timur raksi* (100g *timur* added) respectively and R_1 is the Control Sample collected from Rolpa.

Alcohol content (ethyl alcohol) in different water cycle

Figure 8 show alcohol content variation across different water cycles. Significant differences were found in the first and second cycles between R_2, R_3, and R_4. Fluctuations in alcohol content may be due to uneven heating (Lainez et al., 2021). Longer distillation and repeated cycles reduced alcohol content. Lower values (19.74%-30%) were reported by Ghosh et al. (2016) and Manandhar (2020). Ethanol decreased from head to tail fractions, as noted by Balcerek et al. (2017). Higher alcohol content here may result from more effective saccharification and added jaggery. Thapa et al. (2015) reported up to 40% alcohol in some Nepalese areas, with variability due to fermentation conditions and procedures.

Average alcohol content of *timur raksi* (mixing with four cycles)

Average alcohol content of *timur raksi* is graphically represented in Table. 4 The average ethanol content in R_2, R_3, and R_4 was similar. Control sample R_1, purchased from Rolpa, had 39.89±0.27% ethanol. All samples (R_1, R_2, R_3, and R_4) were statistically similar. The decrease in ethanol in R2, R3, and R4 may be due to mixing samples from five water cycles with varying ethanol concentrations.

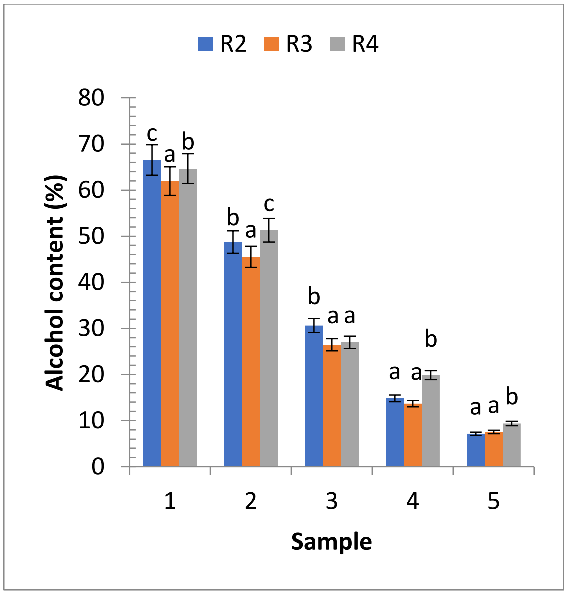

Figure 8 Alcohol content as ethyl alcohol in different water cycle of timur raksi

Bars having similar alphabets (a,b,c) are not statistically significant different by LSD at p>0.05

*Samples were coded R_2, R_3 and R_4 denoting *timur raksi* (50g *timur* added), *timur raksi* (75g *timur* added) and *timur raksi* (100g *timur* added) respectively. 1, 2, 3, 4 and 5 denoted first cycle, second cycle, third cycle, fourth cycle and fifth cycle of distillate samples R_2, R_3 and R_4 respectively.

Table 4 Average alcohol content of *timur raksi* (mixing with four cycles)

Samples	Alcohol content (%)
R_1	39.89 ± 0.27^a
R_2	40.15 ± 0.35^a
R_3	40.04 ± 0.60^a
R_4	40.44 ± 0.27^a

The values in the table are the mean of the triplicates±standard deviation.

Means± standard deviation within the column followed by same alphabet (superscript^{abc}) are not statistically significantly different at p<0.05 according to ANOVA test with post hoc test LSD.

*R_1=Control Sample collected from Rolpa, R2= *timur raksi* (50g timur), R_3= *timur raksi* (75g timur), R_4= *timur raksi* (100g timur)

Yield of final product (*timur raksi*)

Individually, 4 liters of final distillate (*timur raksi*) were made from fermented mash R_2, R_3, and R_4 with varying *timur* concentrations. In sample R_2, R_3, and R_4 yields were found to be 88.49%, 88%, and 87.53% respectively. Same value (82.5–88.7%) obtained from Ademiluyi *et al.* (2013).

Comparision between components identified on GC-MS analysis

Table 5 shows the comparision graph between identified chemical components from GC-MS. GC-MS identified eleven components from samples R_1, R_2, R_3 and R_4.

Table 5 ***Comparison between identified chemical components from GC-MS***

Components	Concentration (%)			
	R_1	R_2	R_3	R_4
Propyl alcohol	-	0.19	0.18	0.16
Ethyl acetate	-	0.30	0.28	0.31
Isobutanol	0.33	0.67	0.74	0.8
Acetal	-	0.03	0.04	0.05
Fusel oil	0.45	0.76	1.12	1.14
Acytol	-	0.20	0.17	0.18
Linalol	-	0.08	0.15	0.39
Ethyl palmitate	-	0.12	-	0.39
D-Limonene	-	-	-	0.14
Pyruvaldehyde	1.24	-	-	-

Samples R_2, R_3 and R_4 are the distillate samples obtained from first water cycle.

* R_1=Control Sample collected from Rolpa, R_2= *timur raksi* (50g timur), R_3= *timur raksi* (75g timur), and R_4= *timur raksi* (100g timur)

Propyl alcohol (Higher alcohol)

Table 5 shows propyl alcohol in R_2, R_3 and R_4, decreasing with added *timur* (R_2>R_3>R_4). Balcerek et al. (2017) noted that volatile compound separation is influenced by solubility in alcohol-water mixtures. Propyl alcohol levels are within the DFTQC (2023) limit (350 g/100ml) and SSD (2014) standard (0.5% higher alcohol). Standards vary by country and regulations.

Fusel oil

Fusel oil concentration increased from sample R_1 to R_4, with R_4>R_3>R_2>R_1. High sugar adjuncts, *murcha*, and high distillation temperatures (Stewart et al., 2017) contributed to this increase. The first 20 ml of distillate was discarded to reduce toxicity, with varying durations needed. Uneven heating between batches also impacted fusel oil levels (Balcerek et al., 2017). The fusel oil content in *timur raksi* exceeds the DFTQC (2023) limit of 350 g/100ml. High amino acids, sugar adjuncts, and yeast rates likely contributed to the high fusel oil, possibly due to *jaggery* and *mana*.

Ester

Ethyl palmitate, ethyl acetate, and acytol were identified in the product. Acytol concentration order was $R_2>R_4>R_3$. Ethyl palmitate only present in R_2 and R_4. Ester changes were linked to *timur* addition and influenced by raw materials, fermentation conditions, and *murcha* microflora (Khadka, 2018). Differences in carbon and nitrogen content also affected ester levels (Subba et al., 2020). Higher alcohol in R_2 and R_4 led to decreased ethyl acetate (Saerens et al., 2010). *Timur raksi*, taken from the first water cycle, had higher ester content, exceeding the DFTQC (2023) limit (100 g/100 l). Ester content varies due to starchy raw materials and distillation temperatures (Nermina et al., 2017; Saurav et al., 2017).

Acetal

The order of acetal concentration of sample was found to be sample $R_4>R_3>R_2$. From this observation we can say that addition of *timur* in different concentration may increases in acetal content of the alcohol. The mandatory value (350 g/100ml) of DFTQC (2023) standard for higher alcohol as amyl alcohol in whiskey and value (0.1%) of Maia *et al.* (2020) of acetal for ester is within the limit.

Isobutanol

Isobutanol increased with timur addition ($R_4>R_3>R_2>R_1$) and concentrated in early head fractions due to its volatility (Berglund et al., 2004). Levels exceeded DFTQC (2023) and SSD (2014) limits of 350 g/100ml and 0.5%, respectively, due to differences in boiling points, still design, and distillation techniques (Stockwell et al., 2020).

Linalool

The order of linalool concentration of sample was found to be $R_4>R_3>R_2$. Sun *et al.* (2021), explain that the specific distillation techniques and conditions employed can also impact the yield and concentration of linalool. Factors such as temperature, pressure, and the design of the distillation apparatus can influence the efficiency of linalool extraction.

D-Limonene

D-Limonene was identified only in sample R_4 in concentration by 0.14%. It was not seen in other samples. Sun *et al.* (2021), said the boiling point of d-limonene is relatively high, around 176°C (349°F). This means that it tends to vaporize and carry over into the distillate during the later stages of distillation when higher alcohol content is present.

Pyruvaldehyde

Pyruvaldehyde was seen in the product R_1 by 1.24% but it was not identified in other products (R_2, R_3 and R_4): as per Parmar *et al*. (2014), the reason may be due to auto-oxidation of sugar, the maillard reaction during storage of the product. The mandatory DFTQC (2023) standard for aldehyde in other whiskey is 350 (g/100ml), hence the pyruvaldehyde content in the control sample is higher than the limit.

Sensory analysis

The mean sensory scores for the samples R_1, R_2, R_3 and R_4 is shown in Fig 9 and describes as below:

Color

Mean scores for color was higher for control sample R_1. Among the 4 samples, statistical analysis showed that there was statistically significant difference in color between R_1 and R_2. *Timur raksi* distilled with different *timur* concentrations showed a white color, with the greatest tinge in the 75g *timur* sample. Color mean values were $R_1>R_3>R_4>R_2$, due to haziness in R_1, R_2, and R_3 from inadequate filtration. Sample R_1 was locally collected, was less hazy due to the filtration. Proper filtration affects color, and Berglund et al. (2004) suggest using softened water for repeated distillation to remove turbidity.

Flavor

Statistical analysis at 5% significance showed no significant differences among samples R_1, R_2 & R_4 and R_2, R_3 & R_4. Panelists noted that R4 had a strong Sichuan flavor, R_3 a base flavor, and R_2 a rich *timur* flavor. Esters, which provide fruity and floral aromas, are crucial in whiskey (Saerens et al., 2010). Linalool, present at 0.15% in R_3, contributed to its unique aroma and high panelist acceptance (Sun et al., 2021; Ji et al., 2019).

Mouthfeel

Statistical data show no significant difference in mouthfeel between R_1, R_2 & R_4 and R_3 & R_4. R_3 had the highest mean scores. Nermina et al. (2017) noted higher alcohols and esters can improve mouthfeel, while Watson (1986) mentioned excessive esters can impair quality. Panelists preferred R_3 for mouthfeel, followed by R_4, R_2 and R_1, likely due to its moderate

Research Article
J. Food Sci. Technol. Nepal, Vol. 14 (19-28), 2024
ISSN : 1816-0727

levels of propyl alcohol, acetal, fusel oil, esters, and linalool.

Taste

Sample R3 had the highest mean score, with panelists noting strong *timur* taste in R_2 and mild *timur* in R_3. Tingling and buzzing sensations were likely due to linalool from Sichuan pepper (Ji *et al*., 2019). The lower score for R_1 may be due to a synthetic flavor and lack of alkylamides. R3's higher score is attributed to its moderate levels of propyl alcohol, acetal, linalool, and fusel oil.

After taste

Statistical data showed no significant difference between R_2, R_3, and R_4. The highest mean score for R_3 might be due to its mild linalool presence and alkylamides from *timur* (Ji et al., 2019; Shi et al., 2022), giving a natural aftertaste. Fusel oils, which precipitate as spirit proof decreases, can cause a bitter aftertaste (Berglund *et al*., 2004). The lowest mean score for R_1 may result from a synthetic aftertaste and added water for business purposes.

Overall acceptability

The samples are significantly different from each other. Color, flavor, taste, after taste and mouthfeel have a combined effect on the overall acceptance of *timur raksi*. R_3 had significantly superior at ($p<0.05$) on the basis of higher score. R_3 was preferred by panelists. The highest score in sample R_3 may be due to mild taste, flavour and after taste of *timur*. The data showed that the overall acceptance of *timur raksi* improve with the addition of *timur*, however too much *timur* in the sample was disliked by the panelists.

Selection of the best product

The best product selection was based on mean sensory scores and chemical characteristics. Sensory attributes ranked as follows: color ($R_1>R_3>R_4>R_2$), flavor ($R_3>R_2>R_4>R_1$), mouthfeel ($R_3>R_4>R_2>R_1$), taste ($R_3>R>R_4>R_1$), after taste ($R_3>R_2>R_4>R_1$), and overall acceptance ($R_3>R_2>R_4>R_1$). Panelists preferred R_3 (75g *timur*), while chemical analysis suggested R_2 was also acceptable.

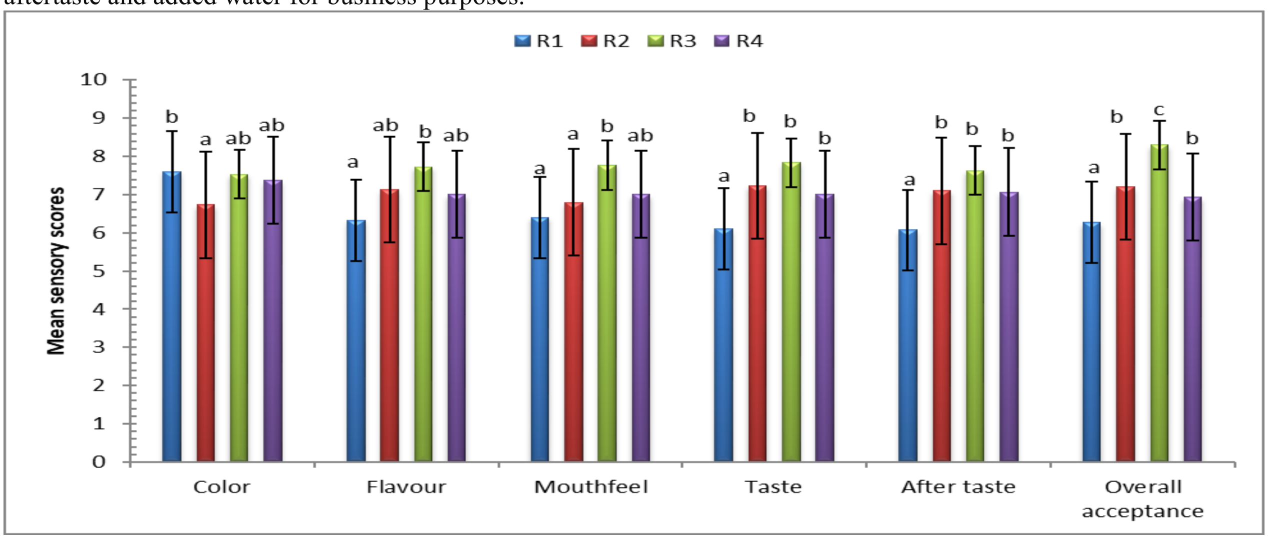

Figure 9*:* The mean sensory scores for the samples R_1, R_2, R_3 and R_4
Bars having similar alphabets (a,b,c) are not statistically significantly different by LSD at $p>0.05$
Samples were coded R_2, R_3, and R_4 denoting *timur raksi* (50g *timur* added), *timur raksi* (75g *timur* added) and *timur raksi* (100g *timur* added) respectively and R_1 is the Control Sample collected from Rolpa.

CONCLUSIONS

In this study, *timur raksi* was prepared using traditional fermentation with *murcha* and varying *timur* amounts (50g, 75g, and 100g). Analysis included reducing sugar, TSS, pH, total acidity, alcohol content, and GC-MS. *Timur raksi*, important in Rolpa for preserving community values and offering new flavors, showed that sample R_3 (75g *timur*) was preferred by panelists, while chemical analysis favored sample R_2. *Timur raksi* is more affordable and accessible compared to market-flavored whiskey, suggesting that traditional *murcha* can keep beverage costs low. It can be prepared at home for personal use following the provided procedure.

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